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Economic Analysis of Effluent Guidelines for the Soap & Detergent Ind.

Colin A. Houston & Associates, Inc.

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The soap and detergent industry is characterized by a highly concentrated oligopolistic market in which, according to 1970 census data, the first four companies accounted for 70% of the value of shipments and the first eight companies accounted for 79%.

Price competition is limited except in the liquid detergent field. In the marketing of household products advertising plays an important role in product differentiation.

On the basis of size, the industry was segmented into the first four, the first eight, "rest of the industry" basis. Segment I company sales ranged from $400,000,000 to over one billion dollars. Aggregate plant data indicates that the efficiency of the three groups corresponds generally to their ordering.

Simulation models of representative single plant producers (see next page)

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in the industry indicate that on a point source basis the cost to the industry of the recommended control guidelines and standards is appreciable, impacting smaller producers relatively more heavily than larger producers. This point source approach is an indirect approach in assessing control costs.

Since most of the industry interconnects with public waste treatment facilities, the greatest potential cost impact of effluent control will come from rising public waste treatment charges.

No adverse community, employment, or balance of payment effects are anticipated.

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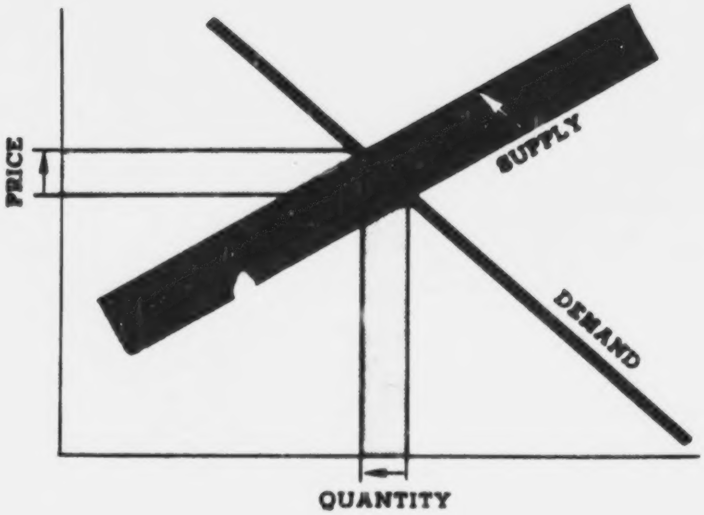

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ECONOMIC ANALYSIS
OF
EFFLUENT GUIDELINES
FOR THE
SOAP AND DETERGENT INDUSTRY
PHASE I

JULY 1976

by

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Contract Number 68-01-1566

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PREFACE

The attached document is a contractor's study prepared with the supervision and review of the Office of Planning and Evaluation of the U.S. Environmental Protection Agency (EPA). Its purpose is to provide a basis for evaluating the potential economic impact of effluent limitations guidelines and standards of performance established by EPA pursuant to sections 304(b) and 306 of the Federal Water Pollution Control Act.

The study supplements an EPA technical "Development Document" issued in conjunction with the promulgation of guidelines and standards for point sources within this industry category. The Development Document surveys existing and potential waste treatment and control methods and technologies within this category and presents the investment and operating costs associated with various control technologies. This study supplements that analysis by estimating the broader economic effects (including product price increases, continued viability of affected plants, industry growth and foreign trade) of the required application of certain of these control technologies.

This study has been submitted in fulfillment of Contract No. 68-01-1566 by Colin A. Houston & Associates, Inc. Work was completed as August 31, 1973. The study is based primarily upon an earlier study, also prepared by Colin A. Houston & Associates, Inc., entitled "Economic Analysis of Proposed Effluent Guidelines for the Soap and Detergent Industry". The earlier report was circulated in conjuntion with the publication in the Federal Register of a notice of proposed rulemaking under sections 304(b) and 306 for the subject point source category. The analysis contained in the original study has been revised based upon information received during the period of time between publication of the notice of proposed rulemaking and the promulgation of the final regulation. The data base of this study, however, is essentially the same as that used in the earlier study. Because of the constraints of time, the control and treatment costs analyzed in this study may not in all instances be identical to those associated with the requirements of the promulgated regulation. However, those differences, when they exist, are minor insofar as the final conclusions of the study are concerned.

This report represents the conclusions of the contractors. It has been reviewed by the Office of Planning and Evaluation and approved for publication. Approval does not signify that the contents necessarily reflect the views of the Environmental Protection Agency. The study has been considered, together with the Development Document, information received in the form of public comments on the proposed regulation, and other materials in the establishment of final effluent limitations guidelines and standards of performance.

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INTRODUCTION

Pursuant to the Federal Water Pollution Control Act Amendments of 1972, Colin A. Houston & Associates, Inc. (CAHA) was engaged by the EPA on January 16, 1973, Contract 68-01-1517, to undertake a technical study of the soap and detergent industry for the purpose of assessing its role in water pollution. Carrying out its assignment, CAHA identified and described the various manufacturing processes employed in producing soaps and detergents. Having done so, CAHA then studied the effluent streams associated with each manufacturing process. The nature and quantity of the pollutants in each stream was ascertained by sampling and analysis. Next, with a full knowledge of the processes and pollutants to be encountered in the industry, treatment technology was reviewed to find technically feasible means of achieving pollution control. Finally, all factors uncovered in the CAHA study were carefully weighed and effluent limitation guidelines recommended.

In the Federal Water Pollution Control Act Amendments of 1972, Congress directed the EPA, in promulgating effluent limitation guidelines, to consider the economic and social costs involved and their relationship to the economic and social benefits to be obtained. Thus, in carrying out its mandate insofar as it applies to the soap and detergent industry, EPA let a second contract, #68-01-1566, to CAHA on June 25, 1973 to assess the economic impact of the guidelines recommended in the earlier CAHA technical study.

This report on the economic impact of the proposed effluent limitation guidelines and standards for the soap and detergent industry, SIC 2841, deals with the industry in terms of its products, its participants and its technology. Aggregate data for the industry is analyzed on both an intraindustry and interindustry basis. The ranking of the industry vis-a-vis concentration ratios with respect to worker productivity is reviewed. Data on an establishment basis is also analyzed. Then industry growth and geography are reviewed. Next, a microanalysis is undertaken, identifying the "big three" in the industry within the context, the number, and size distribution of the industry participants. The industry is then segmented for further study: Segment I is made up of the first four largest companies in the industry. Segment II is made up of the second four largest companies in the industry. Segment III is made up of the rest of the companies in the industry.

The oligopolistic nature of the industry is analyzed with respect to price competition, advertising, product differentiation, barriers to entry, and price elasticity of demand.

It is generally concluded from the available data that the relative impact of the proposed effluent limitation guidelines and standards, recommended by the guideline contractor, will fall most heavily on Segment III and least heavily on Segment I.

It is predicted that the economic impact of the guidelines will increase manufacturing costs especially for the smaller less efficient producer. As manufacturing costs increase, it is predicted that there will be a corresponding increase in prices.

EXECUTIVE SUMMARY

INTRODUCTION OF SUMMARY OF IMPACTS

As shown in this report, the impact of effluent limitation standards and guidelines recommended for the soap and detergent industry is of serious consequence to both large efficient companies and the less efficient smaller companies.

METHODOLOGY

In assaying guideline impact, a number of tasks were completed. For example, the industry was defined in terms of its product, its participants and its technology. A macroanalysis was made. Aggregate data on the industry as a whole was analyzed on both an intra-industry and inter-industry basis. Factors considered included the rank of the industry vis-a-vis concentration ratios with respect to worker productivity; industry growth; and geography. A microanalysis was made in which individual companies were analyzed. The "big three" in the industry were identified vis-a-vis context, number and size. Finally, three hypothetical plants were modeled for the purpose of analyzing the financial impact of the effluent guidelines. The data base is current as of 1973.

SEGMENTATION

For detailed study, the industry was divided into three segments. Segment I comprised the four largest companies in the industry. Segment II comprised the second four largest companies. Segment III included the remaining companies.

Segment I

Procter & Gamble Company
Lever Brothers Company
Colgate-Palmolive Company
Purex Corporation, Ltd.

Segment II

Amway Corp.
Armour Dial Division, Greyhound Corp.
Economics Laboratory, Inc.
Chemed Division, W.R. Grace and Company

Segment III

Remainder of the industry

Segment I, with the exception of Purex Corporation, Ltd., is composed of multinational corporations having individual annual sales in excess of a billion dollars, most of which is derived from the sale of household products. Purex sales are estimated at $400 million for 1973.

Segment II comprises medium sized companies, or soap and detergent divisions of large companies, generally strong in specialty and industrial products.

Segment III comprises the balance of the industry, over 350 companies whose sales range from $20,000 to $50,000,000 per year.

Aggregate plant data indicates that the efficiency of the three groups corresponds generally to their ordering.

Segment III has high cost of materials and payrolls when measured against the average. Segment II has the lowest cost of materials and Segment I has the highest ratio of production workers to total employees and the lowest payroll as a percentage of value added.

Technical Study

The economic impact statement contained herein builds and costs three model plants. The models are impacted with Level I, Level II, and Level III guidelines.

Level I - BPCTCA - Best practicable control technology currently available

Level II - BATEA - Best available technology economically achievable

Level III - BADCT - Best available demonstrated control technology

The models hypothesized are:

1. A small soap company
2. A small liquid detergent company
3. A very large integrated soap and detergent company

All of the models are postulated to be single plant companies. The in process changes necessary for the small plants to meet the guideline raw waste loadings are postulated and costed. It is evident from this study that if these raw waste loadings were required as pretreatment standards, the viability of the small companies would be in jeopardy.

The large integrated soap and detergent company is costed to meet the recommended raw waste loadings and then the secondary treatment given to the wastes to meet the guideline recommendations is costed. Although the costs are significant, they are supportable within the economics of the large plant.

One assumption had to be made to bring out the effect of the guidelines, namely, each plant had to be considered as a separate profit center and company in itself. This is not general industry practice - usually a product is considered to be a profit center and costs assigned to the various plants manufacturing that product gathered into one total manufacturing cost; and profitability is calculated on a product basis, not a plant basis. Attempting to establish guidelines costs relative to such accounting practice would be impossibly complex.

The Level III case in each instance is evaluated as representing a new facility operated at manufacturing capacity from the initial on-stream date. Each process unit necessary to operate the total plant at capacity is treated similarly.

The study of the models bears out the industry segmentation and confirms the potential seriousness of the guidelines to the small operator. The price effect is discussed in the economic impact, and it is obvious that if the small companies are to install process changes to reduce raw waste loadings, prices will have to be raised.

It is pointed out that demand is inelastic with respect to price and should thus support a price increase. Here again, however, the incremental cost per pound of product for the small company is substantially higher than that for the larger firm, indicating a potential deterioration in the small company's business position.

Economic Study

The nature of the industry is analyzed with respect to price competition, advertising, product differentiation, barriers to entry and price elasticity of demand.

The soap and detergent industry is characterized by a highly concentrated market in which, according to 1970 census data, the first four companies accounted for 70% of the value of shipments and the first eight companies accounted for 79%.

Since the market leaders already possess large shares of the market, they would probably like to avoid any further dominance that would expose themselves to public censure and possible punitive action by the government. Therefore, the market leaders may have to raise prices sufficiently to keep from squeezing smaller producers who will be severely impacted by the guidelines. Whether this effort will succeed is problematical. The weakest members of the industry must attempt to raise more capital to meet pollution guideline standards. This will be a severe strain on their viability.

The available data supports the conclusion that the relative impact of the proposed effluent limitation guidelines and standards, recommended by the guideline contractor, would fall most heavily on Segment III and least heavily on Segment I.

Since over 98% of the plants in the soap and detergent industry are not point sources of effluent, but send their effluent to publicly-owned treatment facilities, the immediate obvious impact of point source guidelines on this industry must be very small. On the other hand, the industry may face very heavy forthcoming sewer charges from publicly owned treatment facilities when these facilites endeavor to meet their new treatment standards and guidelines.

One real economic impact of the industry point source guidelines will soon become apparent. The point source guidelines limit and establish the cost of the alternate to publicly-owned treatment for the very large plants of the industry, most of whom have access to navigable water.

This then is the opportunity cost of publicly-owned treatment for the large plants of the industry. It is the point at which that portion of industry must consider so far as practicable the alternative to publicly-owned treatment.

Contrasted with the large producer is the small company which is presently using publicly-owned treatment. For the small producer the option of becoming a point source is severely limited by:

1. Geography - the small plants are frequently located within the confines of a major metropolitan area with no access to navigable water.

2. Technology - industrial wastes such as those from a small soap and/or detergent plant would preclude smooth operation of a small package treatment plant. The technical and laboratory staff to provide supervision of a package treatment plant under frequent upset conditions would be economically unsupportable.

For the small producer who must then use publicly-owned treatment, an important possible effect is the impact of the recommended guidelines and standards on publicly-owned pretreatment requirements.

Justification for Additional Segments

Additional segmentation could be made between the manufacturers of household soaps and detergents and manufacturers of industrial cleaning compounds. Contrasted with the immense amount of data on treatment of household products under both aerobic and anaerobic conditions, very little is known about the treatability of industrial cleaners. Until at least preliminary treatability studies are conducted on industrial cleaners, it is impossible to make a meaningful economic study based on this type of segmentation.

COST

The guideline contractor made the cost analysis used in constructing the model plants practicable by the method used to categorize the industry. The industry was broken down into the basic process building blocks.

Soap Manufacture

Code	Process Description
101	Soap Manufacture - Batch Kettle and Continuous
102	Fatty Acid Manufacture by Fat Splitting
102H	Fatty Acid Hydrogenation
103	Soap from Fatty Acid Neutralization
104	Glycerine Recovery and Concentration
105	Soap Flakes & Powders
106	Bar Soaps
107	Liquid Soap

Detergent Manufacture

Code	Process Description
201	Oleum Sulfonation & Sulfation (Batch & Continuous)
202	Air SO_3 Sulfation and Sulfonation (Batch & Continuous
203	Solvent and Vacuum Sulfonation
204	Sulfamic Acid Sulfation
205	Chlorosulfonic Acid Sulfation
206	Neutralization of Sulfuric Acid Esters & Sulfonic Acids
207	Spray Dried Detergents
208	Liquid Detergent Manufacture
209	Detergent Manufacturing by Dry Blending
210	Drum Dried Detergents
211	Detergent Bars & Cakes

Utilizing these building block processes which are described in the guidelines report, any detergent or soap plant configuration can be simulated and costed.

In establishing costs for the model plants all raw material costs were tabulated and checked with industry sources. Each of the above processes was carefully costed utilizing information on capital and operating costs from contractors serving the industry as well as those obtained from searching and updating literature estimates. Treatment costs were arrived at by analysis of current industry point source treatment costs and also by checking against treatment costs in related industries.

FINANCIAL PROFILE

The financial analysis of the economic impact study concerns itself with the impact of the proposed standards and guidelines on the economic viability of three groups of companies making up the industry. Segment I is made-up of the four largest companies in the industry. Segment II is made-up of the next four largest and Segment III is made-up of the balance of the industry.

In order to measure the impact of the control standards on these groups, models were constructed of three different types of hypothetical companies reflecting characteristics of the three groups mentioned above. The companies were given a complete set of financial characteristics based on Dun and Bradstreet key financial and profitability ratios. The profile itself is the culmination of intensive research into the characteristics of the industry based on data developed from the *Census of Manufactures*, *Standard & Poor's* and *Moody's* financial services, 10K Reports filed with the Securities and Exchange Commission and access to a questionnaire sent out by industry trade associations.

These models were then impacted with the control costs of Levels I, II and III technologies and the impact on profitability and risk were observed. In all cases the impact is substantial, but in all cases it is expected that the incremental costs associated with effluent control would be offset by price increases.

Table 1

Soap and Detergent Processes Expected To Require Modification Due To Guideline Recommendations

Soap Manufacture

Code	Processes	Level I	Level II	Level III
101	Kettle Boil Soap	X	X	C
102	Fat Splitting	N	X	C
102H	Fatty Acid Hydrogenation	N	N	N
103	Soap From Fatty Acid Neutralization	N	N	N
104	Glycerine Recovery	X	X	C
105	Soap Flakes & Powders	N	N	N
106	Bar Soaps	N	X	C
107	Liquid Soap	N	N	N

Detergent Manufacture

Code	Processes	Level I	Level II	Level III
201	Oleum Sulfonation	X	X	N
202	SO_3 Sulfonation	X	X	C
203	SO_3 Vacuum Sulfonation	N	X	N
204	Sulfamic Acid Sulfation	X	X	C
205	Chlorosulfonic Acid Sulfation	X	X	C
206	Neutralization of Sulfamic Acid Esters etc.	N	N	N
207	Spray Dried Detergents	N	X	C
208	Liquid Detergents	X	X	C
209	Detergent Dry Blending	N	N	N
210	Drum Dried Detergents	N	N	N
211	Detergent Bars & Cakes	N	X	C

Note: The code numbers refer to the effluent limitation guidelines report.

X indicates modification is required for the process in the appropriate Level to meet effluent limitations.

N indicates no change is expected to enable process to meet the guideline recommendations.

C indicates the process is a new point source where there may be an economic disadvantage over already in-place capital with regard to a net addition to total cost.

IMPACTS

Prices

It is hazardous to estimate the price impact of the proposed effluent standards and guidelines since so much depends on EPA rulings regarding publicly-owned treatment and the actions of the publicly-owned treatment plants in their interpretations and subsequent assessment of charges. Also, many of the larger companies can revert to point source if publicly-owned treatment charges become too burdensome. The point source guidelines to them represent an opportunity cost of publicly-owned treatment. Retail sales prices in this industry generally run two to three times the profited plant cost for consumer products. A mark-up of 50 - 100% over the plant profited cost is typical of industrial products. Thus, a ½¢/lb increase in plant cost could mean a 1½¢/lb increase in retail sales price or a ½¢/lb increase in the price of an industrial chemical.

Plant Closings

No plant closings are anticipated.

Unemployment

No unemployment is anticipated from guideline imposition.

Community Impact

No community impacts are anticipated.

International Trade

As the international balance of payments shifts there may be some change in capital allocation within the multinational Segment I companies, but the total capital necessary to meet the Level I and II guidelines to have solely point source plants is still modest for such substantial companies, i.e., under $ 30 million. Accordingly, no major shifts are anticipated, nor are prices likely to have to be increased sufficiently to increase imports of SIC 2841 products.

Other

Through three trade associations, The Soap and Detergent Association, The Chemical Manufacturers Specialties Association, and the Industrial Sanitary Supply Association, the economic impact contractor is conducting an information study.

Pertinent economic information has been elicited from member companies on a confidential basis. The study deals with company finances and requests information regarded as very sensitive and also the replies are voluntary. Some companies are answering a question in detail that other companies decline to answer at all. Twenty-two company replies received to date represent a helpful mosaic which was used in constructing the model plants in this report. Also, the study confirms the vulnerability of a number of small companies to any increase in sewer charges from publicly-owned facilities.

LIMITATIONS

The great uncertainty in estimating the impact of point source guidelines on a non-point source industry is the further actions which will be taken by EPA and municipalities. For example, on July 19, 1973, during preparation of this report, EPA proposed pretreatment standards for industrial contributions to publicly-owned treatment works. These proposed standards classify three pollutants quantified in the contractor's guidelines: fats and oils, chemical oxygen demand and surfactants as incompatible pollutants. Incompatible pollutants, under certain circumstances, then must be subjected to best practicable control technology currently available as pretreatment. If this definition of compatability stands and if pretreatment is required for these pollutants, the costs of the point source guidelines to this industry will increase tremendously. The economic effect of such a ruling is not covered in this report and would require an additional study.

I. INDUSTRY CHARACTERISTICS

A. DEFINITION OF THE SOAP AND DETERGENT INDUSTRY

This report deals with the soap and detergent industry as it is described under Code 2841 in the Standard Industrial Classification Manual prepared by the Statistical Policy Division of the Office of Management and Budget. Neither code number nor definition of this industry changed between 1963 and 1967.

As defined, this industry comprises establishments primarily engaged in manufacturing soap, synthetic organic detergents, inorganic alkaline detergents or any combination thereof, and also establishments producing crude and refined glycerine from vegetable and animal fats and oils. Establishments primarily engaged in manufacturing shampoos or shaving products, whether from soap or synthetic detergents and also establishments producing synthetic glycerine are classified elsewhere.

Value of shipments and other receipts of the soap and detergent industry in 1967 totaled 2.3 billion dollars, volume for 1973 is estimated to be 2.8 billion dollars; see Table 2.

The detailed list of products and their basic quantity measure as reported in Census are shown in Table 3.

The 2841 grouping includes a number of separate distinct business areas which are discussed separately below:

1. Household Soaps and Detergents
2. Industrial and Institutional Cleaners
3. Glycerine
4. Fatty Acids

Following is a discussion of these business areas.

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Table 2

SUMMARY VALUE OF SHIPMENTS OF SOAPS AND DETERGENTS - SIC 2841
MANUFACTURERS' LEVEL
(After 1967 Census of Manufacturers)

	1963 (in millions)			1967 (in millions)			Estimated 1973 (in millions)		
	Kilograms	Pounds	Dollars	Kilograms	Pounds	Dollars	Kilograms	Pounds	Dollars
All Soaps	605.1	1332.8	355.0	563.1	1240.3	383.9	540	1190	415
Glycerine Natural	63.6	140.0	26.0	65.8	145.0	36.0	68	150	35
Alkali Detergents	519.0	1143.2	200.2	670.1	1476.0	279.6	888	1955	385
Acid Type Cleaners	156.1	343.8	35.2	256.1	564.0	61.7	399	878	101
Synthetic Org. Det. Household	2098.7	4622.7	1029.4	2513.5	5536.4	1235.4	3170	6982	1565
Synthetic Org. Det. Non-Household	287.2	632.6	115.3	357.5	787.4	141.1	443	976	167
Soap and Other Det., NSK	38.6	85.0	17.6	166.2	366.0	73.2	332	732	146
Grand Total Soaps and Detergents	3768.3	8300.1	1778.7	4592.3	10115.1	2210.9	5840	12864	2814

SOAPS AND OTHER DETERGENTS - SIC 2841

CODE	DETAIL PRODUCT LIST	QUANTITY MEASURE
2841	SOAP AND OTHER DETERGENTS - MC-28F	(finished weight)
28411	ALKALINE DETERGENTS AND ACID-TYPE CLEANERS	
	Alkaline detergents, household (products sold in containers holding 25 pounds or less and 1 gallon or less and for use by family units)	
	Machine dishwashing compounds	
28411 11	Liquid	M gals.
28411 13	Dry (solid)	M lbs.
	Other alkaline detergents, household	
28411 15	Liquid	M gals.
28411 17	Dry (solid)	M lbs.
	Alkaline detergents, nonhousehold (bulk products and products sold in containers holding over 25 pounds or over 1 gallon, and for industrial, institutional, or commercial use regardless of package size)	
	Machine dishwashing compounds	
28411 21	Liquid	M gals.
28411 23	Dry (solid)	M lbs.
	Other alkaline detergent, nonhousehold	
28411 25	Liquid	M gals.
28411 27	Dry (solid)	M lbs.
	Acid-type cleaners containing an acid and/or wetting agent, and/or inorganic fillers	
28411 71	Dairy and food processing cleaners	M lbs.
28411 75	Metal cleaners	M lbs.
28411 79	All other	M lbs.

TABLE 3

CODE	DETAIL PRODUCT LIST	QUANTITY MEASURE
		(finished weight)
28412	SOAPS, EXCEPT SPECIALTY CLEANERS, NONHOUSEHOLD	
	Nonhousehold soaps (bulk products and products sold in containers holding over 25 pounds or over 1 gallon, and for industrial, institutional, or commercial use regardless of package size)	
28412 15	Chips, flakes, granulated, powdered and sprayed, including washing powders	M lbs.
28412 27	Liquid (potash and other, excluding shampoos)	Gals.
28412 61	Mechanics' hand soaps, pastes, and bars, except waterless	M lbs.
28412 98	Other soaps, nonhousehold	M lbs.
28413	SOAPS, EXCEPT SPECIALTY CLEANERS, HOUSEHOLD	
	Household soaps (products sold in containers holding 25 pounds or less and 1 gallon or less, and for use by family units)	
	Bars (excluding medical and medicated mechanics'hand soap and shaving soap)	
28413 11	Toilet	M lbs.
28413 13	Laundry and other household soaps (bars)	M lbs.
28413 22	Chips, flakes, granulated, powdered, and sprayed, including washing powders	M lbs.
28413 51	Medical and medicated soaps (containing medicinal or germicidal or other additives only as a deodorant), bars, liquid, and paste	......
28413 61	Mechanics' hand soaps, all types except waterless	M lbs.
28413 98	Other soaps, household	M lbs.
28414	GLYCERINE, NATURAL	
28414 11	Crude, 100-percent basis	M lbs.
28414 31	High-gravity, dynamite, and yellow distilled, 100 percent basis	M lbs.
28414 51	Chemically pure, 100-percent basis	M lbs.
28415	SYNTHETIC ORGANIC DETERGENTS, HOUSEHOLD	
	Household detergents (products sold in containers holding 25 pounds or less or 1 gallon and less, and for use by family units)	
	Dry (solid)	
28415 21	Light-duty	M lbs.

CODE	DETAIL PRODUCT LIST	QUANTITY MEAS (finished weight
	Heavy-duty	
28415	Anionic base	M lbs.
28415 25	nonionic base or other base	M lbs.
	Liquid (excluding shampoos)	
28415 31	Light-duty	M gals.
28415 35	Heavy-duty	M gals.
28415 39	General purpose cleaners	M gals.
28415 53	Scouring cleansers with or without abrasives	M lbs.
28416	SYNTHETIC ORGANIC DETERGENTS, NONHOUSEHOLD Nonhousehold detergents (bulk products and products sold in containers holding over 15 pounds or over 1 gallon, and for industrial, institutional, or commercial use regardless of package size)	
	Dry (solid)	
28416 21	Anionic base	M lbs.
28416 29	Nonionic base or other base	M lbs.
	Liquid	
28416 31	Anionic base	M gals.
28416 39	Nonionic base or other base	M gals.
28416 53	Scouring cleansers with or without abrasives	M lbs.

TABLE 3 (cont'd)

Household Soaps and Detergents

This business is segmented by broad product groupings as follows:

Soap		Typical Name Brands
a)	Bar	Lux (Lever), Ivory (P&G), Dial (Armour-Dial), Sweetheart (Purex), Palmolive (Colgate-Palmolive)
b)	Package	Ivory Flakes (P&G)
Synthetic Detergents		
a)	Heavy duty powders	Tide (P&G), All (Lever), Fab (Colgate-Palmolive)
b)	Light duty powders	Dreft (P&G)
c)	Heavy duty liquids	Wisk (Lever), Dynamo (Colgate), Era (P&G)
d)	Light duty liquids	Joy (P&G), Trend (Purex), Vel (Colgate), Dove (Lever)

Soaps

Total soap sales are estimated at 1.19 billion pounds in 1973 including 225 million pounds of industrial soaps valued at 55 million dollars and 965 million pounds of household soaps valued at 360 million dollars. The soap business is presently static in terms of volume with about a 4%/yr. growth in dollar sales due to inflation. However, this last year with the prices of fats and oils soaring and such key oils as coconut and tallow doubling in cost in 12 months, the soap business may in the future suffer a serious decline as on a cost effectiveness basis it becomes increasingly uncompetitive. On the other hand soap today is more a cosmetic personal care product and is not purchased by the consumer on a cost effectiveness basis.

The household soap business is strongly dominated by Procter & Gamble with Ivory and Camay and by Armour-Dial with Dial, the leading deodorant soap, while Lever Brothers with Dove, and Colgate with Palmolive have far lesser shares.

Synthetic Detergents

The heavy duty powders are used for home washing of cotton and synthetics. The light duty powders are used for fine fabric washing. The light duty liquids are designed for hand dishwashing, while the heavy duty liquids compete with the heavy duty powders for home laundry use.

The heavy duty powders represent almost 70% of the dollar volume and the liquids 30% of synthetic detergents. About 3.8 billion pounds of solids are estimated to be sold in 1973 and one billion pounds of liquids. P&G has over half the market on the solids, Lever and Colgate each have about 15% and all other producers such as Sears, Winn-Dixie, Purex, etc. about 15%.

Retail sales price for solids averages 30¢/lb. making total retail value about $1.1 billion.

In liquid synthetics P&G has 35% of the market with Colgate at 10% and Lever at 20%. The other 35% is held by a host of companies with Purex the largest at about 5%

Retail sales price for the light duty liquids for dishwashing is 42¢/lb.

Heavy duty liquids sell in the 45¢/lb. range, making the total retail value of liquids about $425 million.

The other important categories of household detergents are machine dishwashing compounds estimated in 1973 to be $133 million and general purpose household cleaners $200 million.

Industrial and Institutional Cleaners

Industrial and institutional cleaners are a large and fast growing market estimated to be $650 million in 1973. Included in this group are industrial machine dishwashing compounds ($100 million) dairy and food processing cleaners, metal cleaners ($135 million), car washing compounds, commercial laundry products, commercial rug cleaners, floor cleaners, tank car cleaners and a host of other specialty applications. The dominant companies in this business are DuBois, division of Chemed (a division of W.R. Grace), Stauffer and BASF but there are hundreds of small firms manufacturing specialty industrial cleaning compounds. Capital requirements are low. All that is required is the knowledge of a special cleaning need and an ingenious compounder to come up with a satisfactory product to start up a business. Advertising and distribution costs are modest.

Glycerine

Another area of overlap in guideline writing concerns glycerine. The contractor has recommended a guideline on natural glycerine. Synthetic glycerine is covered in industry

2869 (per the 1972 SIC Manual), U.S. glycerine production is estimated as follows:

Table 4

United States Glycerine Production
(in million pounds)

Year	Natural	Synthetic	Total
1972	150	198	348
1971	134	201	333
1970	130	189	339
1969	148	200	348
1968	160	202	362

Total U.S. production of glycerine rose from 160 million pounds in 1940 to 339 million pounds in 1970. Since 1968 production has been fluctuating in the 330 to 370 million pound range, as can be seen above. Current U.S. synthetic capacity is 320 million pounds/yr. The list price for glycerine has fluctuated between 18¢ per pound and 30¢ per pound over the period 1955 to the present. The current price is 23½¢/lb. as of July 1973.

The natural glycerine producers are the key to the pricing on this product since they must market their product - a by-product of soap and/or fat splitting - regardless of price. The synthetic producers follow the pricing set by the natural producers.

The cost of recovering natural glycerine will increase if the recommended guidelines are adopted. This could result in a small price increase. The market price leader in glycerine is Procter & Gamble. One option available to Procter & Gamble would be to increase prices to cover pollution abatement costs. The increases involved are not large enough to affect market elasticity. Specific costs are discussed under the process heading.

Fatty Acids

An area not covered entirely in Table 2 is the fatty acid business. Where fatty acids are produced and used captively by the major soap companies in soap production, they are included as intermediates in the soap figures as shown in Table 3, since they are key intermediates in the manufacture of soap. On the other hand fatty acids that are produced for sale by non soap companies are not included in Table 1. Production of three important acids is:

Table 5

Production of Selected Fatty Acids
(in million pounds)

Year	Lauric & Myristic	Stearic
1972	20.8	300.0
1971	24.4	279.0
1970	25.0	283.0
1969	25.0	302.6
1968	18.0	280.6

Source: Fatty Acid Producers Council

In writing guidelines for the soap and detergent industry, the contractor took the building block approach and divided the industry into eighteen processes. It was thus necessary to write a guideline for the process of fatty acid manufacture as employed by the soap companies in their manufacture of soap.

B. ECONOMIC AND FINANCIAL CHARACTERISTICS

1. Introduction

The purpose of this chapter is to establish a framework for testing the economic feasibility of the effluent limitation guidelines and standards of performance proposed for the soap and detergent industry. The economic and financial characteristics of the industry are explored in order to establish relatively homogeneous groups of companies within the industry, to facilitate the impact analysis. The establishment of such groups permits tentative judgments to be made relative to the expected impact of the effluent limitation guidelines and standards on representative elements of the industry. Census data, rather than data from the Annual Survey of Manufactures is used in this study because of the greater reliability and comparability of the Census data with other data used in this study.

2. Macroanalysis (Analysis of Aggregate Data)

The soap and detergent industry as described in the Standard Industrial Classification Manual is composed of "establishments primarily engaged in manufacturing soap, synthetic organic detergents, inorganic alkaline detergents, or any combination thereof, and establishments producing crude and refined glycerine from vegetable and animal fats and oils." The inclusion of any particular company or establishment in this industrial classification is based upon the fact that it produces a primary product of the industry as defined above, and further, that that product has a value greater than the value of other products it may produce but which are not included in the above definition. For example, Company X produces soap and food products, but its primary value product is soap. Consequently, it is not classified in the food product industry but instead is classed as a member of the soap and detergent industry.

The Census of Manufactures indicates that for the year 1967, the most recent census year for which there is data, the soap and detergent industry establishments shipped product with a total value of $2,593.4 million of which $1,990.2 million represented primary products, the basic product of an industry as indicated under the Standard Industrial Code; $405.7 million represented secondary products, products produced by establishments within the industry with a total value that is less than that of the primary product; and $197.5 million represented miscellaneous receipts. The primary product specialization ratio is 83, indicating a high proportion of primary product to total product for the industry. As defined by the Department of Commerce, the specialization ratio is the ratio of all primary product of

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establishments in the industry to the total of primary plus secondary products. For the same year, 1967, the total primary product made in all industries was $2,200.8 million, which includes $210.6 million of primary product made by other industries. These data yield a coverage ratio of 90, indicating a high proportion of total production of primary product within the industry as defined. The coverage ratio is the value of the primary product made within the defined industry divided by the total primary product made by all industries.

Table 6 below presents industry data classified by the number of workers employed by establishments for the year 1967. The term "establishment" is not comparable with "company." It is more comparable with "plant" since respondent companies were required to report separately for each location.

Industry Concentration - 1967 Data

The number of establishments and size distribution in Table 6 indicates that of the 668 establishments in the industry, 287, or 43% of the establishments, employ 1.7% of all employees and 2% of all production workers; while 4 establishments, or 0.6% of total establishments, employ 19.5% of all employees and 22.5% of production workers. In addition, 12 establishments, or 0.8% or the total, employ 37.7% of all employees and 42% of production workers and 28 establishments, or 4.2% of the total, employ 57.5% of all employees and 64.5% of production workers.

These data indicate a relatively high degree of concentration of productive facilities within the industry. The degree of concentration is probably understated since the data are presented on an establishment basis rather than a company basis. Since the larger the company the more likely it is to be a multi-plant producer, presentation of the data on a company basis should increase the level of concentration.

Industry Productivity - 1967 Data

Assuming for the present that these observations concerning concentration in the industry are correct, it is useful to consider the relationship between concentration and productivity. Again, because of the limited nature of the data with respect to the method of reporting "establishments" rather than companies, only tentative conclusions can be drawn concerning the relationship between concentration and productivity on a company basis. Referring again to Table 5, we can utilize "Value of Shipments" and "All Employees, Number" to derive a measure of employee productivity. Such a measure is indicative of the value of output per unit of

Table 6

General Statistics, by Employment Size of Establishment: 1967

		All employees		Production Workers							
	Esta-blish ments (num-ber)	Number (1000)	Pay-roll (mil-lion $)	Number (1000)	Man-hours (mil-lion)	Wages (mil-lion $)	Value added by manufac-ture (mil-lion $)	Cost of mate-rials (mil-lion $)	Value of ship-ments (mil-lion $)	Capital expendi-tures, new (mil-lion $)	End-of-year inven-tories (mil-lion $)
841 - Soap and Other Detergents											
stabs.' Total	668	30.3	243.0	20.0	40.1	145.3	1403.7	1202.0	2593.4	48.1	250.5
stabs. With an Average of -											
1 - 4 Employees[e]	287	.5	3.0	.4	.6	1.6	10.3	9.2	19.4	5.2	1.8
5 - 9 Employees	85	.6	3.8	.3	.6	1.7	10.3	11.5	21.8	.4	2.0
10 - 19 Employees	89	1.3	8.7	.7	1.3	3.4	30.4	31.6	61.5	.7	5.3
20 - 49 Employees	105	3.5	23.7	1.6	3.2	9.1	81.4	81.5	162.0	2.1	14.3
50 - 99 Employees	50	3.5	24.8	1.9	3.8	10.9	104.7	99.9	203.8	3.8	17.9
100 - 249 Employees	24	3.6	25.4	2.3	4.4	13.4	148.2	103.2	249.8	3.2	26.0
250 - 499 Employees	16	6.0	50.6	4.5	9.1	34.5	352.6	310.9	662.5	11.8	59.5
500 - 999 Employees	8	5.5	52.5	3.9	8.2	35.0	352.8	325.7	675.4	11.4	62.1
1000 - 2499 Employees	4	5.9	50.8	4.5	8.8	35.8	312.9	228.6	537.1	9.4	61.6
stabs. Covered by Admin. Records[1e]	238	.4	2.2	.4	.5	1.3	8.3	7.4	15.7	(Z)	1.7

Over 30 percent of the data for this line was estimated.

Report forms were not mailed to companies that operated only one establishment and which Social Security payrolls indicated had fewer than 10 employees. Actual payrolls (and sales) for 1967 were obtained from administrative records of the Federal Government. The other statistics for these establishments were estimated from industry averages.

ource: Census of Manufacturers, 1967

labor input only. It is not, for example, a measure of physical output per unit of labor input.

Value of Shipments per Employee

Value of Shipments per employee, for the industry as a whole, is $85,590, with a range of $36,333 - $122,800 per employee. For the 28 largest establishments representing 4.2% of all establishments, the value of shipments per employee is in excess of the industry average by upwards of 6.4%

Value of Shipments per Production Worker Man-Hour

The 4 largest establishments do not appear to be the most productive based on this measure of labor productivity. Value of shipments per production worker man-hour, is $64.70 for the industry as a whole, with a range of $32.30 - $82.40 per production worker man-hour. The value of shipment per production worker man-hour for the 4 largest establishments, however, is $61.00, below the industry average by a significant amount. The next 24 establishments have an average value of shipment per man-hour in excess of the industry average by upwards of 12.5%

Value Added per Employee

Value added per employee for SIC 2841 in 1967 is $46,327. The range for establishments by employment size is $17,167 - $64,154 per employee. One finds that the largest 28 establishments previously mentioned, representing 4.2% of all establishments, have a value added per employee in excess of the industry average by an average of at least 15%. It is interesting to note here, as well as with regard to data presented below, that the 4 largest establishments show a lower productivity differential than do the next 24. It may be that the optimum sized establishment lies within the range of 500 - 999 employees, the average size consistently showing the greatest labor productivity of all establishments. However, any conclusions on this point based on such limited data would be tenuous.

Value Added per Production Worker Man-Hour

Lastly, the measure, value added per production worker man-hour, has a range of $17.20 - $43.00 per hour, with an overall industry average of $35.00 per hour. The 28 establishments representing 4.2% of all industry establishments have an average value added per production worker man-hour of 1% or more in excess of the industry average.

At no time have any of the rankings, vis-a-vis other industries, appeared below the first quartile.

A Reconciliation of Establishment and Company Data

It is axiomatic that eggs and oranges cannot be compared. With this in mind, the next step is to compare the data developed for establishments with that developed for companies in order to determine whether establishment data are a good proxy for company data. The problems here are twofold: (1) the latest establishment data are from the 1967 Census while the latest company data are from the 1963 Census; (2) establishments conform more to plant data than to company data.

First, comparing summary data for establishments and for companies for 1963, we find striking similarities. Reference to Table 6 indicates that the differences in per employee data are so small as to be insignificant while the differences in the man-hour data are also very small and, in fact, may be magnified due to rounding. Second, one may recall that, based on the value of shipments between 1963 and 1967, there was a reduction of 2 percentage points in the concentration figures for first-4 companies and first-8 companies, or a decline of 2.8% for first-4 companies and 2.5% for first-8 companies, and there was no change in the first-4 for 1970 and a 1 percentage point increase for the first-8. Therefore, one can conclude that there has not been an appreciable change between the 1963 census and the 1967 census with regard to the first-4 and first-8 companies in the industry.

Table 7

SELECTED INDUSTRY DATA ON AN ESTABLISHMENT BASIS AND ON A COMPANY BASIS - 1963

Census Year	Value of Shipments per Employee	Value of Shipments per Man-Hour	Value Added by Manufact. per Employee	Value Added by Manufacture per Man-Hour
1963 As reptd. for Estab.	$69,084	$51.89	$36,929	$27.74
1963 As reptd. for Cos.	$69,098	$52.00	$36,937	$28.00

One may therefore feel justified in making the following assumptions with regard to these data: (1) 1963 establishment data for SIC 2841 are a good proxy for 1963 company data, at least for the largest companies, and (2) there is little reason to believe that anything has happened within the industry since 1963 to change that relationship.

3. Microanalysis (Analysis of Specific Industry Data)

The soap and other detergent industry data have thus far been analyzed in a highly aggregate form. At this point, the analysis will move to an examination of the general characteristics of this industry and the participants within the industry.

Industry Growth

Sales of soap and other detergents will probably show continued growth through the decade at approximately 3% per year. Synthetic detergents continue to be the strongest factor in the industry showing a year-to-year growth rate of 8%

Almost 5 billion pounds of synthetic detergents are used annually for home laundering. Commercial laundries are shifting to the use of synthetic detergents as they replace worn out equipment which required the use of soap, water softening equipment and high operating temperatures.

In 1971 the annual growth rate for value of product shipments, 1967-1971, was 5% per year. The ratio of net profits to net worth was 13%.

Industry Geography

The major producing areas for the industry in the United States are the East, North Central and Middle Atlantic States. The North Central Region provides about 50% of the industry's total shipments.

The Market Participants and Products

As has already been demonstrated, the soap and other detergents industry is a highly concentrated industry, regardless of the method used to determine the number and size distribution of the companies in the industry.

Since the Bureau of Census does not make public the identity of the companies it surveys, one can only estimate the number of companies that can be classified as SIC 2841. From an inventory of companies undertaken for this study, using various sources to classify the companies, it is estimated that there is a total of somewhere between 325 and 350 companies in the industry. The census data, by establishments, would indicate there are a greater number of companies.

Because of data limitations, these micro data are not always comparable with the macro data of the Census. This analysis must proceed on the basis of the net sales of the participants and other company income statement and balance sheet data. On a net sales basis, the first-4 and first-8 companies are shown in Table 8.

Table 8

FIRST-4 AND FIRST-8 COMPANIES SIC 2841

First-4 Participants are:

Procter and Gamble Company
Lever Brothers
Colgate-Palmolive Company
Purex Corporation Ltd.

First-8 Participants are:

Procter and Gamble Company
Lever Brothers
Colgate-Palmolive Company
Purex Corporation Ltd.
Amway Corporation
Armour-Dial, Div. of Greyhound Corporation
Economics Laboratory, Inc.
Chemed, Div. of W. R. Grace Company

These companies are in SIC 2841 primarily through the sale of household laundry and cleaning products such as soaps and other detergents. Because of the high degree of concentration in this market, it is conventional in the industry to group the first-3 companies, known as "the big three"; i.e., Procter and Gamble, Lever Brothers, and Colgate-Palmolive. These first-3 companies account for between 80% and 85% of the package detergent market. Therefore, the remaining companies account for 15% to 20% of the market.

Procter and Gamble   Table 9

PROCTER AND GAMBLE COMPANY
FIVE YEAR FINANCIAL HISTORY
($ MILLIONS)

	Foreign Sales (a)	Domestic Sales (a)	Total Net Sales	Income Before Tax	Net Income	% Net Profit Margin	% Ratio Net Income to Net Worth
1972	973	2541	3514	515	276	7.9	18.50 (b)
1971	788	2390	3178	447	238	7.5	17.0
1970	739	2240	2979	435	212	7.1	16.7
1969	671	2036	2708	376	187	6.9	16.1
1968	631	1912	2543	355	183	7.2	16.5

(a) Based on fact that net income from foreign operations was 27.7% in 1972, 24.8% in 1971. Latter proportion was used to adjust sales 1968-1971.

(b) Based on average net worth for period.

The company is engaged primarily in a single line of business, household products, which accounts for approximately 85% of net sales. No single part of the remaining institutional and industrial business amounts to as much as 10% of sales.

The company's principal products include: laundry and cleaning products such as detergents, soaps, fabric softeners, cleaners and cleansers; personal care products such as bar soaps, toothpastes, mouthwash, deodorants, shampoos, paper tissue products, paper towels and disposable diapers; food products such as shortenings and oils, cake mixes, peanut butter and coffee; and other miscellaneous products. The household products are distributed, principally, through grocery stores and other retail outlets.

In 1972 laundry and cleaning products accounted for 43% of net sales. For the period 1968 to 1972, laundry and cleaning products accounted for between 43% and 46% of net sales.

International operations consist, to a very large degree, of the manufacture and sale of household products in Europe, Great Britain, Canada and parts of Latin America, Asia and Africa.

For the five years 1968 to 1972, net sales increased from

$2,542,615 thousand to $3,514,438 thousand, or 38%. For the same period, net income after taxes increased from $202,026 thousand to $276,310 thousand, or 37%. The return on common equity was 18.5% for 1972.

The company employs 30,000 people in the United States.

Lever Brothers Table 10

UNILEVER N.V./LEVER BROTHERS
FIVE YEAR FINANCIAL HISTORY
($ MILLIONS)

	Unilever N.V.	Lever Brothers		
Year	Sales	U.S. Net Sales	U.S. Profits	Profit as % of sales
1972	8330	527	12.7	2.4
1971	7526	522	11.1	2.1
1970	6883	525	8.8	1.7
1969	6030	491	5.2	1.1
1968	5534	452	11.9	2.6

The data for Lever Brothers are limited because the company is a subsidiary of Unilever N.V., a Dutch holding company whose sales are also shown for comparison. Household soaps and detergents are a substantial share of the sales of Lever Brothers. For the five years 1968 to 1972, sales for Lever increased from $452,000,000 to $527,000,000, or 17%. Net income increased from $11.9 million to 12.7 million, or 7%, for the same period. No data are available for the rate of return on common equity.

Colgate-Palmolive Table 11

COLGATE-PALMOLIVE
FIVE YEAR FINANCIAL HISTORY
($ MILLIONS)

	Foreign Sales	Domestic Sales	Total Net Sales	Income Before Tax	Net Income	% Net Profit Margin	Ratio Net Income Net Worth
1972	940	868	1808	139	68	3.7	13.5
1971	802	802	1604	121	56	3.5	12.6
1970	702	761	1463	104	50	3.4	11.9
1969	636	747	1383	105	48	3.5	11.7
1968	605	710	1316		46	3.5	11.7

The company is engaged largely in the household and personal care fields. Household products account for approximately 77% of net sales.

Colgate's principal household products are laundry detergents, laundry pre-soaks, laundry bleaches, dishwashing detergents, cleaners and window cleaners, dentifrices, mouthwashes, kitchen towels, plastic bags, food wraps, air fresheners, spray starches, non-liquid heating materials and moth control substances.

Colgate's products are manufactured and distributed in both the United States and more than 40 foreign countries. Their distribution varies to meet local requirements.

In 1972 the company acquired the Kendall Company, a manufacturer of professional products for hospitals and health care institutions.

During the period 1968 to 1972, laundry and dishwashing detergents, included under household products, contributed from 30% to 33% of net sales. In 1972, they accounted for 30% of net sales.

Between 1968 and 1972, international operations accounted for about 46% to 52% of net sales with the 1972 figure being 52%. Approximately 61% of consolidated net sales outside the United States during 1972 was concentrated in Australia, Canada, France, Germany, Great Britain, Italy and Mexico. No one country represented more than 16% of such sales.

For the five years 1968 - 1972, net sales increased from $1,315,559 thousand to $1,807,632 thousand, or 37%. For the same period, net income, after taxes, increased from $45,874 thousand to $67,541 thousand, or 47%. The return on common equity in 1972 was 13.5%. This includes the Kendall Company acquired in 1972.

The company employs 17,500 people in the United States.

Purex Corporation   Table 12

PUREX CORPORATION LTD.
FIVE YEAR FINANCIAL HISTORY
($ MILLIONS)

	Net Sales	Income Before Tax	Net Income	% Net Profit Margin	% Net Income to Net Worth
1972	364	29	15	4.1	13.5
1971	352	27	13	3.8	12.8
1970	327	26	13	3.9	12.4
1969	287	31	14	5.0	13.1
1968	256	24	13	5.1	14.5

The company produces products under the following classifications: consumer products, automotive engine services and industrial, institutional and commercial products.

Consumer products include a broad line of bleaches, soaps, detergents and scouring and other cleaning products for household use, a line of drugs and toiletries, certain agricultural products, some specialty foods and swimming pool chemicals and equipment.

The principal household products manufactured and sold by Purex are liquid and dry bleaches, liquid and dry detergents and soaps, several varieties of toilet bar soaps - including deodorant bar soaps - scouring cleansers, bluing, disposable steel wool soap pads, cleanser pads, copper stainless steel cleaners, a fabric softener, ammonia and starch. The company also manufactures liquid and dry bleaches, cleansers, bar soaps and detergents for sale under the private labels of grocery store chains and drug stores.

The company sells its product in both national and regional markets.

Certain household products such as Brillo steel wool products, Dutch Cleanser and various bleaches are manufactured in Purex-operated plants in England, Ireland, Australia and Canada and in licensee-operated plants in the Philippine Islands and Mexico.

The company employs 8,300 persons.

For the period 1968 to 1972, consumer products accounted for 60.5% to 63% of sales and revenues of the company. In 1972 the proportion was 61%.

For the same five year period, sales and revenues increased 42% from $255,667,000 to $363,722,000. Net income after taxes increased 16% from $13,014,000 to $15,033,000. The return on common equity for 1972 was 13.5%.

Amway Corporation

The Amway Corporation is a privately held company located in Ada, Michigan. Through a network of home dealers, Amway sells personal care items to households throughout the country. A substantial plant is located at Ada, Michigan where detergent products are manufactured. Total sales volume in 1973 of Amway is estimated at 150 to 200 million dollars. It was not possible to obtain any detailed financial data due to the fact that this is a privately owned company.

Armour-Dial, a subsidiary of the Greyhound Corporation

Armour-Dial manufactures a wide variety of products including soaps, deodorants and other personal care products; ironing aids, floor waxes, detergent and other household products, canned meats, pizza mixes and other packaged food products as part of their grocery products line. They also manufacture ethical prescriptions for humans and animals.

Their 1971 sales were apportioned as follows:

Personal care products	34%
Household products	9%
Food specialties	37%
Pharmaceuticals	16%
Other	4%
	100%

Sales and financial history show:

	1972	1971	10 mos. to 11/2/68
Sales	$260,441,450	$235,625,945	$168,284,000
Net Income	$15,808,553	$13,413,843	$ 9,289,000
Common Stock	10,319,169 shares	10,317,000 shares	10,317,000 shares
Capital Surplus	$42,640,768	$42,602,636	$ 43,216,000
Earned Surplus	$44,509,716	$30,764,914	$ 9,289,000

The Armour-Dial Division employs 2,700 people. Since Armour & Company and Armour-Dial have been consolidated into Greyhound, data on Armour-Dial as an entity is not now available.

Economics Laboratory, Inc.

The company develops, makes and sells chemical products for cleaning and sanitizing uses. Principal products include detergents, disinfectants, drying agents and solvents for institutional, commercial and custodial use. Products are also made for warehouse washing, food service, hospital, animal care, bakery and laundry sanitizing. The company also makes detergents and rinse additives for home washers and many other specialized cleaners.

The company employs 3,600 people.

For the five years, 1968 to 1972, sales increased 73% from $89,063 thousand to $154,263 thousand. Net income for the same period increased from $5,420 thousand to $9,652 thousand or 77%. The rate of return on the common equity for 1972 was 17.5%.

Chemed Division of W. R. Grace & Company

This division of W. R. Grace & Company, a highly diversified conglomerate corporation, is one of the chemical divisions of the company. Chemed accounted for 6% of net sales of the parent company in 1971.

Chemed's products include amino acid chelating agents, sarcosine surfactants and other specialties used in soap and detergent manufacturing, textile processing, water treatment and other industrial applications.

Sales of Chemed rose from $83 million in 1968 to $124 million in 1971. For that 4 year period, sales increased by 49%. In 1971 Chemed, after taxes, contributed 13% to W. R. Grace and Company's income.

Industry Segmentation

At this juncture, having examined the number and size distribution of the industry members, it is possible to divide the industry into three groups for further study. Given the fact that the first-3 companies represent between 80% and 85% of the package market, it would seem logical to use the first-3 companies as the first group. This, however, would make the analysis of impact more difficult since census data are published in groupings of not less than 4 companies. Therefore, since the census data are a very important source of data, it is necessary to use the first-4, and the first-8 designations in the industry. For this reason, the industry is grouped as follows:

TABLE 13

SIC 2841 IMPACT

Segment I

Procter and Gamble Company
Lever Brothers Company
Colgate-Palmolive Company
Purex Corporation Ltd.

Segment II

Economics Laboratory, Inc.
Amway Corporation
Armour-Dial Division of Greyhound Corporation
Chemed Division of W.R. Grace & Company

Segment III

All other companies in the industry

The impact analysis revolves around separately impacting each of the three groups in order to determine the effect of the effluent limitation guidelines and standards of performance. In addition to publicly available data, data has been obtained via a questionnaire that was prepared for the purpose.

Plant Data - No individual plant data are available at this point in the study. The only source of any usable data is the 1967 Census of Manufacturers, establishment data.

The 1967 Census data are arranged as follows:

Group I - The first 4% of total establishments on a value of shipments basis.

Group II - The first 7% of total establishments on a value of shipments basis.

Group III- Must necessarily be a residual. It is what remains after Groups I and II have been constructed.

Plant Efficiency - Since no disaggregated plant data are available at this point in the study, an estimate of aggregate plant efficiency by Group will be made based on the previously discussed measure of labor productivity, i.e., value of output per unit of labor input. Although there may be many arguments against the use of such a measure, it is still a reasonable gauge of plant efficiency. Reference to Table 14 will show these relative measures of plant efficiency on an aggregate plant basis. (This is really on an approximate company basis since there is no method to disaggregate the establishment data further.)

TABLE 14

VALUE OF SHIPMENTS AND VALUE ADDED AS MEASURES OF EFFICIENCY BY INDUSTRY GROUP FROM ESTABLISHMENT DATA, 1967

	Value of Shipments			Value Added		
	$ Mil.	$ Per Employee	$ Per(d) Worker Man-Hour	$ Mil.	$ Per Employee	$ Per(d) Worker Man-Hour
Group I(a) First-28 Establishments	1,875.0	107,759	71.84	1,018.3	58,523	39.02
Group II(b) Next-24 Establishments	249.8	69,389	56.77	148.2	41,167	33.68
Group III(c) All Remaining Establishments	468.6	49,851	49.33	237.2	25,234	24.97
Industry Average	2,593.4	85,590	64.67	1,403.7	46,327	35.00

Source: 1967 Census of Manufactures, page 28D 10.

(a) Should be 26.72 establishments therefore data are probably understated but not significantly, since it agrees with 1963 concentration ratio. 1963 company concentration ratio: 72% for value of shipments. Group I concentration ratio: 1,875.0/2,593.4 = 72.3%.

(b) Should be 20.04 establishments therefore data are probably understated. 1963 concentration ratio = 80%, for value of shipments. Group I and Group II = 81.9%.

(c) Group III is therefore probably understated. Based on 1963 concentration ratio = 20%. Group III = 18.1%.

(d) Includes only production workers.

Group I Relative to the Industry Average - The only above average group of the three groups is Group I. When one considers that Group I represents 28 of 668 establishments one must be impressed at its effect on the average and at its performance relative to the rest of the industry. Its level of labor productivity is significantly above Group II. Taking the per worker man-hour figures, Group I's value of shipments per production worker man-hour is 26.5% greater than that of Group II. For value added per production worker man-hour, Group I exceeds Group II by 16%. Group I exceeds Group III in these two measures of productivity by 45.4% and 56.4% respectively.

Group II and III Relative to the Industry Average - When comparing Groups II and III to the average for the industry one finds that Group II is below the average on value of shipment per production worker man-hour by about 12% and below the average value added per production worker man-hour by about 4%, quite close to the average. Group III is below the average for the industry for these same two measures of productivity by 24% and 29% respectively.

Summary of the Data - These data would seem to suggest that the Group I establishments are very efficient, Group II establishments are about average and Group III establishments are quite a bit below the average efficiency of the industry. (Group III being 616 of 668 establishments in the industry as a whole but representing only 18% of the value of shipments.)

One more point should be discussed here. A striking fact concerning this analysis is that when comparing Group III to the industry average one finds that Group III is lower relative to the average for value added per worker man-hour than for value of shipments per worker man-hour - a situation not found with Group II. The reason for this may be that Group III establishments have a relatively high cost of materials and no market power with respect to price; i.e., a profit squeeze.

Key Operating Ratios - In order to verify this last point and to get a further insight into the efficiency of the three groups, a series of operating ratios were calculated on a group basis (Table 15).

TABLE 15

SELECTED OPERATING RATIOS, 1967
(IN PER CENT)

	Prod. Worker as a % of Total Employment	Cost of Materials Per Dollar of Shipments	Cost of Materials and Payroll Per Shipment $	Payroll as % of Value Added
Group I	74	46	54	15
Group II	64	41	51	17
Group III	52	50	64	27
Industry Average	66	46	56	17

Columns two and three in Table 15 seem to verify the observation that Group III has a relatively high cost of materials. The ratio cost of materials per dollar of shipments is above average while cost of materials and payroll per dollar of shipments is above average by an even greater proportion. This latter fact suggests that Group III is a higher cost group than the others with respect to materials and labor. In addition, payroll as a per cent of value added is highest for Group III, yet another indication of the relatively high cost operations of Group III.

Note that in columns 2 and 3, the lowest cost of materials as well as materials and labor is not Group I but Group II. It is further noted that in column 2, Group I is equal to the average, while in column 3, Group I is below the average. Nevertheless, in the important measure of efficiency, payroll as a per cent of value added, Groups I, II and III are ranked in just that order. In the relationship between production workers and total employment, the Groups also ranked: Group I (1), Group II (2) and Group III (3).

The observations made here leave one further observation to be made: Group I has a high materials cost and a low labor cost. The reason may be attributable to the fact that Group I companies make a higher value product mix than do the other groups. The value of shipments per employee is significantly higher than for the other groups.

Economic Impact - It would be premature at this time to evaluate the economic impact of Effluent Limitation Guidelines and Standards of Performance without having applied the incremental cost of the new standards to the cost structure of the companies or plants. However, although nothing can be said with regard to the absolute impact on any of the groups, something can be said about the relative impact of incremental cash outlays that will not generate any offsetting cash inflows. Certainly it can be seen from the data already developed that the relative impact of the incremental cash outlay on Group I will be light while the impact on Groups II and III will be heavier with Group III bearing the heaviest impact.

Group III companies are smaller. They depend on the price umbrella extended by the big three and are probably the highest cost producers. They are also probably more subject to price competition because of their size and the probability that some of them, at least, operate in regional or local markets rather than in the national markets of the Group I and at least part of the Group II companies. In addition, the ability to raise capital probably varies greatly between groups, going from zero difficulty, at least for the "big three," to significant difficulties for some, if not all, Group III companies.

Any further comments concerning the economic impact will have to await the estimation of the absolute impact.

Financial Profiles

The financial profiles have been derived from the models. They are based upon known manufacturing costs and data received in the questionnaires. These models are intended to be a sample cross-section of the industry. They are not intended to be representative of point-source dischargers, since there are very few point-source dischargers.

Constraints on Financing Additional Capital Assets

As previously indicated, there are probably no constraints whatsoever on the "big three" with regard to their ability to finance additional capital assets within reasonable limits. Certainly it is very unlikely that they would have any difficulty whatsoever in sourcing funds to pay for in-house process modifications and treatment equipment. Any one of these three companies could probably expense these items if it chose to do so.

Group II and Group III companies will require more analysis. More crucial here is the cost of the equipment, since the magnitude of the capital sourcing is of great importance in coming to any conclusions. The ability to source capital is a function of several variables. The ability to source capital is a function of risk. Risk can be broken down into two types, (1) business risk and (2) financial risk. Business risk refers to the variability of returns to the business resulting from exogenous forces beyond the control of management. They are inherent in the nature of the business. (Business risk can, however, be reduced through the diversification of assets.) Financial risk refers to the risk associated with the method of financing the business. It relates to the use of leverage, i.e., the addition of debt to the equity base in the sourcing of capital. The existence of these risks and the magnitude of the risk is perceived in the marketplace for funds.

The Risk - Return Ratio - The inducement to save rather than to consume is the return available on the funds saved. That return is a function of the risk involved in lending or investing funds. Thus, any consideration of the ability to source capital funds must consider the risk-return relationship. The greater the total risk perceived in the marketplace by suppliers of funds, the greater will be their demand for additional return to assume the additional risk, whether it be the equity investor who sells shares because the return on his investment no longer compensates him for the level of risk involved, or the potential buyer of equities who waits for a "reasonable price;" i.e., a price that provides a rate of return commensurate with the risk involved.

In the case of the market for borrowed funds, the same relationship exists, although the institutional arrangements may be different in some cases. Aside from trade credit, which arises out of the need of the seller of goods to extend credit in order to finance his sales, the commercial bank is traditionally the initial institutional source of borrowed funds for a business establishment. Trade credit tends to be shorter term than bank borrowing. The banks, as well as other institutional lenders, operate on the risk-return relationship; however, there are (1) levels of risk beyond which they will not lend and (2) limits to how much they will lend. These limits are set by the risk level, the availability of funds, the nature of the relationship between borrower and lender and statutory constraints.

The "Seasoned" Company - The borrower is in somewhat of a paradoxical position. He requires funds to permit his business to expand and grow. Expansion and growth will increase profits, increase the equity in the business and induce lenders to lend; i.e., the company becomes financially "seasoned." Therefore, in order for the small company to become financially seasoned it needs funds, but in order to get funds, it must be seasoned. Because of this situation, it is difficult for small businesses to secure capital. Once they do secure capital and they become profitable and known among lenders, they become seasoned and can "shop around for funds." In addition to the commercial banks, the seasoned corporation has access to private placement financing and public offerings of their debt and equity instruments.

Group I represents well seasoned companies. Group II represents companies which, for the most part, have sources of capital in addition to bank borrowing. Group III probably represents various levels of capital sourcing limitations.

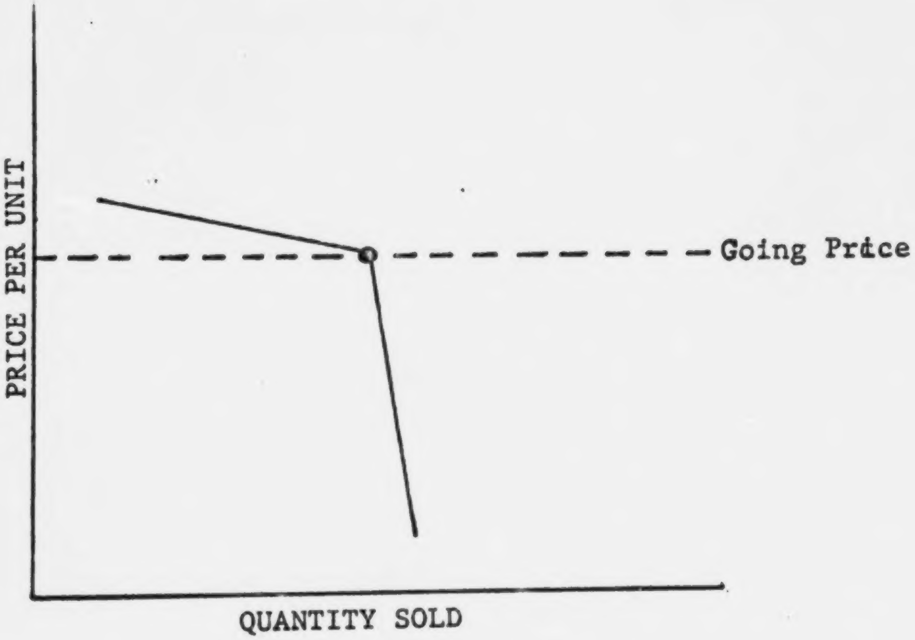
Pricing in This Oligopolistic Market

The soap and detergent industry can be described as essentially oligopolistic by definition, with few sellers having relatively large degrees of market power. With the exception of one product line, light duty liquid detergents, the industry exhibits limited list price competition. Price competition, instead, is carried on by means of a wide variety of special price discounts. These range all the way from straight "cents/off"/carton or case, which is basically price competition, to special offers such as shopping bags, ball-point pens, cellophane tape, and various other premium add-ons or promotional deals.

There is a limited amount of price competition as such in the detergent area by private label (retailers' or wholesalers') brands, but these account for only a minor part of the market.

The very high degree of concentration could lead to a situation whereby the so called "big three" extend a price umbrella over the household soap and detergent industry. Such an umbrella may create oligopolistic profits since it is not based on the cost structure of the most efficient producer. In highly concentrated markets the large competitors cannot help but be aware of each other's cost situation, particularly any changes in these costs. Therefore, price increases generally take place in keeping with an attempt to maintain some type of target profit margins. When these margins get squeezed there is pressure to raise prices. By the same token, downward price movement is induced by a decline in demand, not a current expectation in the soap and detergent industry. Oligopolists recognize their mutual interdependence. Price competition can lead to ruinous price wars, particularly if an industry is confronted with heavy fixed charges.

The Oligopolists Behavior - The oligopolists behavior can, in theory, be described by a kinked demand curve which illustrates the tendency of prices in the industry to remain static. As one can see in the figure on the next page, the upper part of the demand curve has a slope obviously different from the slope of the lower part of the curve.



DEMAND CURVE FACED BY A SELLER
IN AN OLIGOPOLISTIC MARKET

Because of this relationship one can see that any change in price, whatever the direction, will not benefit the price changer. If he increases his price above the going market price and his competitors do not follow, he will lose part of his market share, as well as suffer a decline in total revenue. This is so because the product of his competitors can be purchased at lower prices. If the price changer were instead inclined to decrease his prices and increase his market share at the expense of total revenues, a clear threat to the rest of his competitors, they must immediately retaliate or suffer a loss of market share. Retaliation may result in merely disciplining the price cutter and bringing him back into line or, if the reaction to the price cutting is severe, it could lead to a price war.

There is an additional reason why there is no tendency to decrease prices. Product differentiation creates a relatively inelastic demand curve for the seller with respect to price. When the demand curve is inelastic a decrease in price results in a decrease in total revenues and profits.

By the same token, an increase in price leads to an increase in total revenues and profits.

Product Differentiation - It is obvious that it is in the interest of the classical oligopolist to avoid price competition. It does not mean, however, that there is no competition in an oligopolist market - it only means that there is no price competition.

Product differentiation, coupled with a large advertising budget, is another method of competing. The more the product can be differentiated the fewer close substitutes there will be to compete with it, regardless of relative price increases. Product differentiation involves imparting qualities, either real or imaginary, to a product through advertising, packaging, changing its physical properties, etc. The large advertising budget can constantly keep before the consumer the name of the product made by a particular manufacturer and impart to it differentiated qualities which cause the consumer to purchase it instead of a competing product, even though chemically the competing products may be identical. One example of this is liquid chlorine bleach.

Product differentiation and advertising play an important role in the soap and detergent industry, as can be seen from the following extracts from the Securities and Exchange Commission 1972 10K Reports completed by the Procter and Gamble Company and Colgate-Palmolive Company respectively.

Procter and Gamble

The Company is one of the major producers in the household products field. The market in which these products are sold is highly competitive. In view of this competitive situation, the Company's products are constantly evolving to meet the changing needs and preferences of consumers. In addition to product improvements, new products designed to attract the consumer's favor enter the market in which the company does business. Advertising is used in conjunction with an extensive sales organization because this combination provides the most efficient method of marketing this type of product.

Colgate-Palmolive

Colgate's products are sold under highly competitive conditions in the United States and abroad, primarily through retail grocery, drug, variety and department stores. Competition, based primarily on brand acceptance and marketing capability, is strong in terms of product quality and the number and size of competing companies.

Price Elasticity of Demand - Based on the Wholesale Price Index (WPI) the products of the soap and detergent industry are price inelastic with the one exception of liquid synthetic detergents. In the case of these liquids, the WPI shows an almost continuous decline in price since data became available in 1957. In 1960 the WPI for liquids was at 95 (1957 - 1959 = 100), by 1971 it was 83, a decline of 12 percentage points. For the same period, liquid detergent sales in billions of pounds went from 1.24 to 2.55 (est.), an increase of 106%. For the industry as a whole, the WPI rose from 101 in 1960 to 111 in 1971; detergents, total soaps and synthetics, went from 5.17 billion pounds in 1960 to 6.88 billion pounds in 1971.

The reason for the price elasticity in the case of liquids probably stems from the fact that the companies have not been as successful in achieving brand loyalty with this product as they have with solids. This fact, plus the relatively lower barriers to entry into the liquid market because of the smaller capital requirements has caused competition to increase in this submarket, attracting entrants to exploit the available returns on investment. The relative success in product differentiation with regard to the solids no doubt accounts for the fact that there has been no significant evidence of cross elasticity between liquids and solids. The advent of the newer non-phosphate formulae in liquid form could upset this classic relationship.

C. INDUSTRY MANUFACTURING PROFILE

1. Introduction

Technical Differences - Soaps and Synthetic Detergents Raw Materials

Soaps are made from natural fats, oils or fatty acids of either animal or vegetable origin. To be technically correct one should acknowledge the manufacture of "fatty acids" via synthetic means in Russia and Europe, but not in the U.S. as yet.

Tallow, coconut oil and palm oils are the items of greatest volume used in the manufacture of soaps and the acids derived from fats and oils. Tall oil, a by-product of the paper industry, is also used, primarily for the preparation of industrial soaps and lubricants.

Synthetic detergents are prepared from hydrocarbons and hydrocarbon derivatives almost exclusively of petroleum origin. The hydrocarbons are frequently the linear alkylates of benzene. The derivatives include long chain alcohols as well as ethoxylated products made by reacting the alcohols with ethylene oxide.

The most apparent significant difference between the starting materials of soap and synthetic detergents is that the natural fats and oils are already oxygenated and require only modest further processing whereas the synthetic detergent starting materials must first have an oxygen-containing group added and then be processed similarly to soaps.

Processing

Soap processing from fats and oils has not changed much in over 100 years. Process control has become automated with raw materials charged in at predetermined programmed rates, but the equipment and methodology is largely unchanged. A new dimension has been added within the past thirty years; namely, the preparation of soaps from fatty acids which were obtained by the splitting of natural fats.

Technology very similar to that employed by the chemical process industry is used to process the hydrocarbons and their derivatives into synthetic detergents.

Capital outlays for the soap and synthetic detergent industry are quite modest ($6 - $100/1000 lbs of annual capacity) when compared to the needs of the chemical process industry ($100 - $200/1000 lbs of annual capacity), with some of the more involved chemical processes requiring as much as $400/1000 lbs of annual capacity.

Process Economics

The soap and detergent industry is a low capital-intensive business. The large investment requirements are for purchase of raw materials and marketing. Over 80% of the manufacturing cost is attributable to raw materials, the balance to processing, depreciation, interest, and amortization charges.

Two factors account for the relatively low capital requirements. First, the processing is relatively simple, requiring no high pressure or high temperature. Corrosive conditions are met only in the fat splitting operation. Second, the raw materials and intermediates are very low in mammalian toxicity, thereby requiring no special precautions against leaks, spills or upsets. In the more difficult chemical processes as much as 5% additional capital is required to allow for such precautions.

Process Cleanliness

Several of the soap and detergent processes are essentially "contaminant-free" in that the process consumes all of the raw materials without generating any unusable by-products which end up in wastewater streams. However, even in the case of such units some allowance has been made in the guideline recommendations to accommodate the occasional upset, cleanout or spill. Such a small allowance gives a more economic operation without damaging the environment than would be the case were no discharge mandated.

The concentration and distillation of glycerine is one of the highest contaminating processes of the industry. Average BOD_5s are many times greater than those found in any of the other soaps and detergent making processes. The reason for this is readily apparent. The employment of barometric condensers to reduce the pressure in the equipment causes a significant amount of product to be entrained and carried out in the condenser water. A significant quantity of product (glycerine) is lost in the water stream.

Two of the synthetic detergent processes are worthy of special mention; namely, spray drying and liquid detergent manufacture. The restrictions placed upon the operation of spray drying towers by stringent air pollution regulations have resulted in dilute wastewater streams of large volume which are run to disposal. Liquid detergents also face an equally large problem in the disposal of significant volumes of dilute detergent streams. Because of frequent changes in the products being made and packaged, the mixing and bottle filling equipment must be cleaned out. This usually results in having to handle a greater volume of dilute detergent than can be recycled back into the product, hence it is sent to disposal.

2. Manufacturing Plant Segmentation by Unit Process

In the "Draft Development Document for Effluent Limitations Guidelines and Standards of Performance - Soap and Detergent Industry". the industry was categorized by the processes used for manufacture in order to develop guidelines, as shown earlier. In this section these same segments or categories will be used in briefly reviewing the manufacturing economics of the industry.

3. Soap Manufacture

Soap sales amount to about $400 million per year at the manufacturers' level. Most of the market is in toilet bars for personal cleanliness.

There are two major processes for the manufacture of soap - kettle boiling and the neutralization of fatty acids - which will be treated in a later section. Kettle boiling is now employed in more than 24 locations in the U.S. In practically every instance the equipment is fully amortized.

Batch Kettle

If a new kettle boiling plant were to be built today, it would require approximately $100/1000 lbs of annual capacity - provided the volume approached 20 million pounds per year. It is doubtful that any new capacity would go in as a kettle boiling process. The major contender is the fatty acid neutralization which has a much lower capital requirement ($20/1000 lbs of annual capacity) but a higher raw material cost in the purchase of fatty acids vs. oils.

Another alternative for a new facility would be the continuous saponification of oils carried out in a series of centrifuges used as reactors. In this instance the capital requirement is roughly $40/1000 lbs of annual capacity. This process results in about a 1¢/lb saving in manufacturing cost over kettle boiling.

Prior to saponification, the fats and oils are subjected to cleaning or bleaching processes. One of the last steps in such a process is customarily a vacuum bleaching where low boiling materials are removed by the vacuum created by a barometric condenser. A contaminated wastewater stream fairly high in BOD_5 results. The cleaned fats are then charged to large steel tanks, which in some installations have a capacity approaching 150,000 lbs of material. They are then reacted with caustic and agitated, as well as heated, with live open steam. After several days of reaction and purification, "neat soap" (70% soap solution in water) is drawn off ready for processing into soap products.

A dilute glycerine stream is drawn off as a by-product of soap manufacture. It is concentrated into 60 - 80% solution and sold to a glycerine processor or distilled at the same plant location to a marketable 98+% product.

In the batch kettle processes the processing cost is roughly 1.6¢/lb, including amortization. The raw material cost is about 16¢/lb.

In most operations the only waste that is sent to sewer for disposal is the wastewater resulting from the purification of fats. The guideline recommendations would require the replacement of the barometric condenser by a non-contact surface condenser to essentially eliminate this contamination. Such a step would increase capital requirements by about $2/1000 lbs of annual capacity.

Soap manufacture requires a final purification step in which a dark colored soap solution, referred to as nigre, is drawn off. A plant having a market for such dark soaps can dispose of them in the market place. A smaller plant having no such outlet will have to install a tank for acidulation to break the soap, recover the fats and sell them. Such installations are already being made in order to meet local restrictions. The sale of the fats will make this operation essentially self-liquidating.

The decision to either enter the soap making business or to install new equipment will in no way hinge on the amount of capital required to meet the effluent standards established in the guideline recommendations. As indicated earlier, the replacement of barometric condensers with surface condensers adds about $2/1000 lbs. Further, the process is not capital-intensive.

Soap manufacture - Batch Kettle, coupled with a bar soap operation, could be the basis of a viable new business as well as being the basis of many existing businesses.

Fatty Acid Manufacture By Fat Splitting - Hot fats (around 500°F) are fed under pressure with water into a stainless steel tower, often with an alkaline earth catalyst. Under these conditions the fats are quite soluble in the water and hydrolyze into free fatty acid and glycerine very readily. The fatty acids are subsequently distilled and hydrogenated if needed. The glycerine in turn is concentrated and sent to market.

The capital required for such an operation amounts to about $38/1000 lbs of annual capacity and an operating cost of roughly 1.5¢/lb, including amortization. The fatty acid raw materials will vary from 17¢ to 24¢/lb, depending upon what oil is charged in. For soap making purposes, tallow and coconut oils are the preferred materials to use.

A significant portion of manufacturing processing involves the use of the barometric condenser (for vacuum) in distillation of the acids. The guideline recommendations establish a low enough BOD_5 value to require some modification of this type of equipment, possibly replacing it with a surface condenser. Such an addition would add about $1/1000 lbs of annual capacity. Here again, the decision to enter the fat splitting business will not pivot upon the capital expenditures required to meet effluent guidelines requirements.

Normally, the volume required to make this type of operation competitive is sufficient to make it a business capable of standing by itself. There are fat splitting plants which have a continuous soap making plant in tandem with the fat splitter, making a completely integrated unit.

Glycerine coming out of this operation is often run through a triple effect evaporator, then distilled overhead, ready for market at 98+% assay.

Soap From Fatty Acid Neutralization - Another way in which neat soap is made is by the reaction of caustic with fatty acids obtained from the splitting of fats and oils. A mixture of 80/20 tallow fatty acids/coconut fatty acids is charged to a kettle either on a batch or continuous basis to form the same neat soap described in the batch kettle process.

Capital requirement is around $20/1000 lbs of annual capacity with a processing cost of about 1.5¢/lb, including amortization. Raw material costs will range between 23¢/lb and 33¢/lb. The major advantage of this process over batch kettle is a considerably lower initial capital investment and a much shorter reaction time for soap formation as well as having no by-products to handle. A difference of up to $80/1000 lbs of annual capacity is possible. With the fatty acid neutralization plant one is tied into a much higher cost raw material than batch kettle, giving a raw material cost "penalty" of about 5¢/lb to 10¢/lb.

There is no waste from a process of this type other than an occasional drip from leaking pump packing glands and spills. The guideline recommendations allow a small amount of effluent contamination to accommodate such eventualities. The decision to enter the business of fatty acid neutralization would in no way depend upon the guideline limitations.

Should a firm wish to enter the soap making business, this is undoubtedly the preferred route - particularly on a reduced batch scale.

This process also makes neat soap of 70% concentration which is the starting point of essentially all further soap products manufacture.

Glycerine Recovery - Very dilute glycerine streams (8%) are run into batch concentrators where they are enriched to the 60 - 80% level and most often sold to a glycerine processor, who in turn finishes the job by overheading the glycerine in a still to make 98+% glycerine.

Glycerine concentration requires about \$25/1000 lbs of annual capacity at the 10 million pound level (utilizing triple effect evaporators) with an operating cost of around 2¢/lb. The glycerine still has a capital requirement of about \$15/1000 lbs of annual capacity and an operating cost of roughly 1.4¢/lb at the same volume (10 million lbs/year). The raw material cost is an arbitrary one chosen for a firm doing all of the work internally.

This process has been observed to have a high BOD_5 loading in the wastewater stream flowing from the barometric condensers. The guideline recommendations are such that the barometrics would be expected to be replaced by surface condensers to meet the BOD_5 levels stipulated. This would add about \$14/1000 lbs of annual capacity to the concentrators and \$7/1000 lbs of annual capacity to the distillation unit. Since this is about a 50% increase over the capital for the original process the matter will be given very close financial scrutiny for two possible effects. The first is the ability of current ongoing units to compete with glycerine made from propylene (synthetic glycerine) and the second is the inhibitory effect upon any possible new firm wishing to enter the business. Since the whole network of by-product glycerine make and recovery is in balance for the moment, a new potential structure would have to be contemplated for a situation of this kind.

There are about three dozen plants around the country which either concentrate and/or distill glycerine derived from soap making and fat splitting.

As indicated above, without further thorough study a conclusion cannot be drawn at this time as to the effect the guideline recommendations might have on the economics of glycerine recovery operations. From the field data there is indicated a wide variation in water use and contamination which results in a fairly complicated situation. It is doubtful that, at this time, any one firm would contemplate starting a new glycerine concentration business by itself. The odds of such a situation will be evaluated.

Soap Flakes & Powders - At a capital cost of \$30/1000 lbs of annual capacity this process has one of the lowest processing costs in the group - 0.7¢/lb. Despite this fact, the volume of sales has been declining steadily from 355 million pounds in 1963 to 260 million pounds in 1973. They have been steadily losing out to their counterparts in the detergent area.

The process is quite clean, facing no particular difficulty in meeting the guideline recommendations.

In summary, the larger soap operations will be only mildly impacted by the guideline recommendations; certainly not enough to make the meeting of the limitations a go/no-go situation when considering the possible profitability of any given enterprise.

Bar Soaps - Neat soap made from one of the previously described processes is blended with a variety of fillers, perfumes and oils and then formed into bars via a molding operation. The resulting product is a toilet bar used for personal cleanliness. Since 1963 toilet bars have been increasing in volume slightly but steadily from 635 million pounds per year to 700 million pounds per year in 1973. Mechanics' hand soap and laundry bars have been decreasing substantially over the same period of time.

One of the most important activities that takes place during the formation of bar soap is the reduction of the moisture from the neat soap level of 30% to around 8% - 10% in the final bar. Moisture control and the way it is attained is particularly critical. There are many different ways in which the moisture content is reduced. Some of them result in no wastewater effluent at all while others have a significant loading of a wastewater stream.

As has been seen in a number of previously described processes, the barometric condenser is used to assist in the drying operation. Guideline recommendations for Level II will require some modification of the bar soap activity to reduce the effluent loadings to the levels recommended. If the barometric condensers are replaced, the capital requirements of a 20 million pounds per year plant will go up from $25/1000 lbs of annual capacity to $27/1000 lbs. The operating cost of such an operation comes to a little over 2¢/lb.

The additional capital requirement identified above as needed to meet Level III guideline recommendations are very small and therefore hardly seem sufficient to be solely responsible for a go/no-go decision to enter the business.

Raw materials were not included in this statement since it is basically dependent upon what process was used to make neat soap as to what the resultant incoming raw materials will cost. As noted earlier, they will vary considerably whether the neat soap is from kettle boiling operations or fatty acid neutralization and whether the bar soap operation is part of an integrated train of prior steps.

Liquid Soaps - This is the simplest process in soap making. Neat soap - usually made from fatty acid neutralization - is run into a batch mixing vessel where other ingredients are blended for the particular performance market needed. In some instances the final product is filtered before being drawn off into cans or barrels. Another low capital process, roughly \$30/1000 lbs of annual capacity is required for this type of processing. Raw materials cost about 12¼¢/lb and the manufacturing or processing costs approximately 1.2¢/lb.

There is negligible contamination from this process, so that it is not impacted by the guidelines.

4. Detergent Manufacture

Oleum Sulfonation & Sulfation and Air-SO_3 Sulfation and Sulfonation - Both the oleum (sulfur trioxide dissolved in sulfuric acid) and gaseous sulfur trioxide are used for the initial modifying step of hydrocarbons and hydrocarbon derivatives on their way toward becoming synthetic detergents.

There are many processes in which this kind of chemistry is handled. The two methods cited above account for the vast majority of materials so processed. The oleum process requires about \$15/1000 lbs of annual capacity of capital while the SO_3 process needs about \$32/1000 lbs of annual capacity. The corresponding operating costs range between 0.56¢/lb and 0.9¢/lb respectively. The raw material costs will vary from around 9¢/lb to over 20¢/lb. The volumes used for capital estimating in both instances are 100 million pounds per year of product.

The oleum process is almost completely trouble-free. There are some leaks around the pump packing glands and a rare washout. Other than that the process produces no effluent. Guideline recommendations will have little effect on either in-place plant operation or potential new operations.

The same is not quite true of the SO_3 process. The use of SO_3 requires more alert handling and more frequent washouts due to product degradation, but a well integrated large scale operation will feel no impact of the guideline recommendations. A decision on entering the business will not be influenced by the guideline recommendations.

SO_3 Solvent and Vacuum Sulfonation, Sulfamic Acid Sulfation, and Chlorosulfonic Acid Sulfation - These three processes represent some of the more exotic methods of sulfating or sulfonating. They are chosen either because they represent a way in which to minimize capital equipment cost when paying a premium for the raw materials, or a process which does not readily degrade the raw materials. Usually the resultant products are much more valuable in the market place than those made from processes entitled Oleum Sulfonation & Sulfation and Air-SO_3 Sulfation and Sulfonation. At the 10 million pounds per year level the capital requirements for these processes runs between \$40 to \$85/1000 lbs of annual capacity.

Some of these processes are run at rates below 10 million pounds per year and involve methods of washing out equipment which will be in excess of the effluent limits recommended for these processes.

Neutralization of Sulfuric Acid Esters & Sulfonic Acids - After one of the above reactions described previously, the resulting acid product is neutralized with caustic. The capital requirements are quite modest - $2/1000 lbs of annual capacity. In almost every instance the firm which sulfonates also carries out its own neutralization.

Spray Dried Detergents - This process is the most important and most critical one in the synthetic detergent industry. Typically, the neutralized material from the previously described process is run into a crutcher, mixed with other ingredients and pumped as a 70% slurry to the top of the spray drying tower. The tower is around 150 - 200 feet tall and 25 feet in diameter. The slurry is sprayed through a ring of spray nozzles around the top of the tower and falls through an ascending flow of hot air. By a delicate balance of slurry viscosity, air temperature and air velocity, the synthetic detergent particles of just the right size, density and surface area are produced.

Reduced and no-phosphate formulations have required extensive reformulation including the use of surfactants having markedly different responses to temperature and humidity. Air emission standards have simultaneously been tightened, resulting in heavy discharging of contaminant into wastewater streams associated with the spray tower. There are indications that the problem will become more universal before it is resolved.

Guideline recommendations have acknowledged the dilemma for the present, but insist upon modifications of the process to accommodate a significant reduction in wastewater generation and loadings during the drying operation. In Phase II the impact will be evaluated as to how these requirements may effect the essentially independent operator vs. the highly integrated firm. Here again, there are a few very small firms who also own and operate spray drying towers. What the financial effect or the influence on their competitive ability will be is yet to be established.

For a capacity of 300 million pounds per year in the spray tower, the capital is about $17/1000 lbs of annual capacity. The processing costs amount to about 0.8¢/lb and the raw material cost runs in the neighborhood of 7¢ - 9¢ per pound.

Liquid Detergents

Another important process for synthetic detergent preparation is liquid detergent manufacture. There are two different types of liquids; household and industrial. The household variety assists in all types of cleaning tasks from dishwashing to general house-cleaning. The industrial products are usually a good deal harsher chemically and handle an equally large variety of cleaning activities.

In the household area, the product is mixed in large batch units and then piped to the conveyor lines for filling. Because of frequent product change, the tanks and lines are washed clean - and most of the resulting wastewater is run to the sewer. In the larger, more integrated plants they are able to minimize this disposal problem by blending the wash water back into the product. The smaller operators have considerable difficulty providing that kind of efficiency.

Capital requirements for liquid detergent manufacture runs about $24/1000 lbs of annual capacity with operating costs of around 1.4¢/lb and raw materials in the order of 5¢ to 7¢ per pound.

Detergent Manufacturing By Dry Blending - Many industrial cleaning products are prepared by the dry blending process and by relatively small operators, in contrast to the large major manufacturers of household products. As one might expect, the dry blending process is essentially clean; however, there is need for wet cleanup periodically. There may be some impact upon an occasional operator, primarily because of some of the biologically hard products required to provide the performance characteristics desired.

As with liquid detergents, the capital requirement is modest - $24/1000 lbs of annual capacity. Processing costs amount to approximately 1.4¢/lb and raw materials fall in the range of 6¢ to 8¢ per pound.

Drum Dried Detergents - This old method of preparing dry synthetic detergent products is still employed, usually in operations where industrial products are being prepared. Capital requirements are in the order of $25/1000 lbs of annual capacity with operating costs around 3¢/lb. There is little concern about the financial impact of meeting the guideline recommendations for this process.

Detergent Bars and Cakes - The capital requirement here is estimated at $43/1000 lbs of annual capacity. Increasing volume is being experienced by the major operators in the household field. After a unique method of raw material ingredient preparation, the synthetic toilet bar preparation is quite conventional - almost identical to that of soap bars. Operating costs amount to 2¢/lb and raw materials around 8¢ to 9¢ per pound.

Guideline recommendations insist upon an improvement over the current rather "dirty" operations which is essentially a high loss due to product processing. It is believed that with reasonable diligence the technique can be improved and the guideline met.

5. Effluent Treatment

Most of the soap and detergent manufacturing plants discharge their wastewater effluents into municipal treatment plants. Frequently there is some pretreatment given the raw waste. It is often a fat skimming and settling operation.

Of the plants which are point source dischargers into public waters, the treatment varies both as to the length of time and methodology.

Table 16 gives some insight into the expected operating characteristics of a secondary treatment plant handling the wastewater effluent of an integrated soap and detergent operation. The treatment plant is expected to handle all of the industrial wastes coming from the manufacturing plant's combined process streams. Sanitary streams are handled separately.

The raw flows are sent to an equalization basin, given chemical treatment (alum), clarified and then run into an activated sludge aeration pond. The effluent is regarded as a point source discharge into a natural body of water.

Table 16

Operating Characteristics of a Secondary Treatment Plant

	Raw Influent	Effluent
pH	6 - 11	6.5 - 8.5
BOD_5	1350 mg/l	50 mg/l
COD	3400 mg/l	150 mg/l
Suspended Solids	400 mg/l	30 mg/l
Phosphorus (total)	30 mg/l	8 mg/l
MBAS	520 mg/l	15 mg/l
Dissolved Oxygen	0	1 mg/l

The capital cost of such a plant is expected to be $2.50/gallon of daily capacity and to have an operating cost of roughly 32¢/gallon/year of plant sewage treated.

II. ECONOMIC ANALYSIS

A. THE SCOPE OF THE IMPACT ANALYSIS

Since well over 98% of the plants in the Soap and Detergent Industry are not point sources of effluent, but send their effluent to publicly-owned treatment facilities, the immediate obvious impact of point source guidelines on this industry must be very small. On the other hand, the industry may face very heavy forthcoming sewer charges from publicly-owned treatment plants as these plants endeavor to meet their new treatment standards and guidelines. If this occurs, the true economic impact of the point source guidelines will readily become apparent. For the very large plants, most of whom have access to navigable water, the point source guidelines establish the point at which it becomes less costly to install their own treatment facilities.

Conversely, were the present situation reversed and 98% of the plants represented point sources and possessed their own treatment facilities, the cost of meeting guideline requirements would fix the point at which it would be economically advisable to utilize publicly-owned treatment facilities.

This then, is one of the economic impacts of point source guidelines on the large plants of an industry which is not at present a point source industry - namely, to fix or delineate the point at which that portion of industry must consider so far as practicable the alternative to publicly-owned treatment.

The guideline contractor has made such an analysis possible by using the same method he used to categorize the industry. The industry was broken down into its basic process building blocks. A summary of the impact on unit processes is shown in Table 1.

Utilizing the building block processes which are described in the guidelines report, any detergent or soap plant can, theoretically, be created.

The small company, in contrast to the large producer, is presently using publicly-owned treatment facilities. The small producer's options in regard to becoming a point source are severly limited by:

1. Geography - the small plants are frequently located within the confines of a major metropolitan area with no access to navigable water.

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2. Technology - industrial wastes, such as those from a small soap and/or detergent plant, would preclude smooth operation of a small package treatment plant. The technical and laboratory staff to provide supervision of a package treatment plant under frequent upset conditions would be economically unsupportable.

For the small producer who must then use publicly-owned treatment facilities, an important possible effect is the impact of the recommended guidelines and standards on publicly-owned pretreatment requirements. It is possible that the municipalities might take the waste loadings for the well operated plants in the Level I guideline recommendations and require them as pretreatment standards.

The recommended guidelines very specifically caution that small plants must be given special consideration.

The economic impact statement contained herein builds and costs three model plants such as would be found in:

1. A small soap company
2. A small liquid detergent company
3. A very large integrated soap and detergent company.

All of the models are postulated to be single plant companies. The in-process changes necessary to enable the small plants to meet the guideline raw waste loadings are postulated and costed. It is evident from this study that if these raw waste loadings were required as pretreatment standards requisite to effluent disposal through a publicly-owned sewage plant, the viability of the small companies would be in jeopardy.

The large integrated soap and detergent company is costed to meet the recommended raw waste loadings. Then secondary treatment is given to the wastes to meet the guideline recommendations. Although the costs are significant, they are supportable within the economics of the large plant.

One assumption had to be made to bring out the effect of the guidelines, namely, each plant had to be considered as a separate profit center and company in itself. This is not general industry practice - usually a product is considered to be a profit center and not the various plants manufacturing that product. Profitability is calculated on a product basis, not a plant basis. Costs assignable at all plants making the product are combined into one product cost number to arrive at product profitability. Attempting to establish guidelines costs relative to such accounting practice would be impossibly complex.

The Level III case in each instance is evaluated as a new facility operated at manufacturing capacity from the initial on-stream date. Each process unit necessary to operate the total plant at capacity is treated similarly.

The study of the models bears out the phase I groupings and confirms the potential seriousness of the guidelines to the small operator. The price effect is discussed in the economic impact and it is obvious that if the small companies are to install process changes to reduce raw waste loadings, prices will have to be raised. For the small soap company at least to remain in business there is no choice.

It is pointed out that the market is inelastic and should thus support a price increase. Here again, the ¢/lb cost increment necessary for the small company is substantially higher than that for the larger firm indicating a potential deterioration in the company's overall business position.

B. MODEL PLANTS

To facilitate economic impact assessment, three hypothetical plants representing small, medium, and large operations were synthesized. The creation of these theoretical, composite models was necessitated by the fact that there was no typical manufacturing facility in the soap and detergent industry which could be scaled up or down to give a satisfactory picture of the impact of guideline requirements upon the entire industry. For example, there are a few small to moderate sized plants which manufacture soap products exclusively - and at that, not only bars and chips but liquid products as well. In the detergent field, there are a number of moderate sized plants which custom manufacture spray dried detergents to the exclusion of soaps and other types of detergent products. There are many liquid and solid detergent blending plants, especially in the industrial surfactant part of the business, which do not manufacture soap products. As one might expect, there are a few very large, fully integrated plants which manufacture both soap and detergent products. Some of these plants carry on fat splitting operations and operate substantial glycerine recovery and distillation units. Given this background, it was necessary to postulate model plant operations of varying sizes and degrees of diversification to observe the financial effects of guidelines impact.

Of the eighteen manufacturing processes in the industry, only six are heavy effluent generators. The guidelines recommended for these six will have sufficient impact upon their economics to warrant intensive study to determine whether overall plant profitability is significantly influenced. These processes are:

101 - Batch Kettle Soap Manufacture
102 - Fatty Acid Manufacturing By Fat Splitting
104 - Glycerine Recovery And Distillation
106 - Bar Soap Manufacture
207 - Spray Dried Detergent Manufacture
208 - Liquid Detergent Manufacture

In the case of the first three processes above, it is recommended that barometric condensers be replaced by surface condensers to reduce the high BOD_5 loadings presently found in these processes. This will cause an increase in capital cost.

In the case of glycerine recovery and distillation, the situation is particularly severe. Of all the soap and detergent

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processes, these are the heaviest contributors of BOD_5 to wastewater streams per 1000 lbs of anhydrous product manufactured.

In the spray drying of detergents, ways are presented for reducing the wastewater loading and concomitantly, reducing the BOD_5 sent to sewer. The reduction is accomplished by the introduction of a dual system of water scrubbers to clean the effluent air coming out of the spray towers. Coupled with the scrubber is a refrigeration unit to keep the scrubber waters at an effective chilling and absorbing temperature.

Household liquid detergent manufacture offers a different kind of challenge. This process involves filling of small containers (pints, quarts, etc.). The loss of product is not so much from the actual filling operation on the conveyor belt, as it is from the numerous cleanouts which occur during normal manufacturing operations. Small manufacturers are expected to be more affected than the large integrated units because the initial investment of the small firm is usually more of a marginal nature and their need to change product frequently much greater.

Model plants were created containing principally those operations expected to be heavily impacted by the guideline recommendations.

C. METHODOLOGY FOR ENGINEERING ANALYSIS

As essential background for the model building, detailed flowsheets of all eighteen processes involved in the manufacture of soap and detergent products were developed. Their accuracy and completeness were verified by visits to soap and detergent installations and by discussions with industry experts. From the detailed flowsheets, capital equipment requirements were estimated for each individual process. With the capital in hand, the process costs were established for each class of products in the industry.

In the case of processes producing formulated products, careful structuring of the current formulations was carried out. The use of these formulations was confirmed by reference to currently published reports on the matter and conversations with those experts in the trade.

To insure that the cost values being obtained were reasonably accurate, they were constantly compared with the published prices of many of the intermediates used in the processes.

There was continuing communication with the contractors serving the industry to obtain up-to-date capital and operating expenses for new processes. In a number of cases the capital and operating expenses are the result of these communications and are actual quotations for "turn-key" plants which could be constructed now.

To further insure the up-to-date nature of the cost factors, whenever capital or operating expenses were available from previous estimates made in the literature, etc., the appropriate engineering indices were applied to up-date the economics.

In summary, all of the conventional chemical engineering practices normally employed in the estimation of process economics were applied to develop the most meaningful and current measurement of capital and operating expenses possible short of complete detailed engineering design.

Current spiraling inflationary pressures have confused the process of selecting appropriate raw material costs to be applied in each instance - particularly to the soap side of the business. Even as this review is written, the fats market is going through a very trying time. Reflecting the current shortage of beef for the consumer, the derivative tallow is also becoming difficult to obtain in sufficient supply to maintain operations at a level adequate to meet demand. In the newspapers recently, some major soap manufacturers have indicated the distinct probability of having to shut down part of their soap making operations due to a lack of fats.

On the detergent side, the problem is not severe, in that almost all of the raw materials are synthesized from, or are one or two step derivatives of, petroleum products. The petrochemicals used in the manufacture of detergents, however, have many alternate uses. Their availability is subject to all the factors now causing a shortage of fats. However, the petrochemicals do not usually undergo the extreme supply-demand fluctuations associated with commodities related to agriculture.

D. METHODOLOGY FOR FINANCIAL ANALYSIS

The financial analysis of the impact of the recommended effluent control standards and guidelines is based on three models of producers in the soap and detergent industry. Having developed a unit sales volume, an average selling price and operating cost for time zero and for Levels I, II, and III technologies for effluent control from engineering estimates, a financial profile is derived for each of the three models.

It is the nature of Levels I and II and in all but the most extraordinary cases, Level III control technologies that they represent ex post facto costs to the company. These costs are superimposed upon sunk costs representing investment decisions made and executed previously. In essence, these incremental costs to the firm represent the internalization of what were heretofore social costs; i.e., costs incurred by society as evidenced by the degradation of water quality of rivers, streams, coastal waters, and drinking water sources caused by the emptying of industrial wastes into these bodies of water. This analysis proceeds on a fully allocated incremental cost basis rather than a discounted cash flow basis. Discounted cash flow would be appropriate for analyzing the profitability of a discretionary new investment under the proposed effluent control standards. For existing firms, the additional control costs are mandatory, and must be considered on a fully allocated incremental cost basis.

The financial profile consists of 1) a Statement of Income and Expense, and 2) a Balance Sheet for each of the models, for each of the conditions specified. The specified conditions refer to the assumptions with regard to profitability with specific reference to the after tax rate of return on net worth. For this purpose, use was made of "1971 Key Business Ratios", a publication of Dun & Bradstreet, Inc. For firms in the SIC classifications 2841, 2842, 2843, and 2844, "Soap, Detergents, Perfumes, and Cosmetics", Dun & Bradstreet provides key financial ratios, based on data from sixty-four representative companies. The results of the Dun & Bradstreet analysis are divided into quartiles and presented as "upper quartile", "median", and "lower quartile" data.

Once sales were specified, use was made of these key ratios to construct a balance sheet for each model company based on each level of performance specified for this study. When the balance sheet was completed, the ratio of net profits on tangible net worth was utilized to arrive at net profit after tax for the bottom line of the income statement. From this point a federal income tax rate was selected, and the net profit before federal income tax, as well as the federal income tax liability, was derived. From that point the statement of income and expense was derived using the key operating ratios provided in "Cost of Doing Business Corporations - Soaps, Cleaners and Toilet Goods", one of 185 categories of businesses report by Dun & Bradstreet. While it is recognized that these date represent the results of industries other than the soap and detergent industry as defined by the Standard Industrial Classification Manual, it is felt that they are sufficiently specific to provide a realistic approximation of the soap and detergent industry for the purpose of providing financial data for companies.

Each model represents a single-plant company. (See page 41.) Of the three models used, one represents a small marginal producer of soap; one represents a small successful producer of liquid detergent; and the third represents a large, successful, integrated multi-product producer. The first two models conform to Segment III establishments. The third model conforms to a Segment I establishment. There is no specific model conforming to a Segment II establishment. Two of the companies in Segment II are smaller analogs of the Segment I companies and their financial analysis can be extrapolated from Segment I. The other two companies in Segment II are more sophisticated versions of the Segment III liquid detergent model and financial estimates can be extrapolated accordingly.

These analogies, covering the Segment II establishments, give representative coverage of all three segments of the industry. This includes the largest firms, the medium-sized firms, and the remaining companies in the industry.

More specifically, each model is set up using the median key balance sheet and return on net worth ratios to set them up as "average" companies. They are then each impacted with the costs attendant on the various levels of effluent control technology and the effects are noted. In addition, each of the models is set up applying upper quartile data in the case of the large integrated establishment and small liquid detergent manufacturer and lower quartile data in the case of the small soap manufacturer and again impacted with the various levels of effluent control technology.

The reason that lower quartile data was used only for the small soap manufacturing establishment is that this model is the "acid test". This model is a marginal company. This becomes obvious when one observes that the lower quartile ratio of net profit after tax to net worth is 4.88 percent. It would be unrealistic to use lower quartile data for the other two models. The observed results of impacting these model companies with the effluent control standards and guidelines costs are summarized and generalized for the industry as a whole.

E. MODEL OF A SMALL SOAP PLANT

The model of a small soap plant used in determining whether such a plant can tolerate the impact of recommended effluent limitation guidelines is described in the following paragraphs. It represents a marginal producer with fairly well amortized equipment, a rather well established market and a minimal sales force. In these inflationary times, the firm will have a particularly difficult time in purchasing raw materials. If purchasing is timed correctly, it can make more profit in a rising fats market than on the actual manufacture of soap. Contrariwise, if not hedged, it can suffer severe losses in a declining market.

The model is postulated to produce 4,000,000 lbs/yr of neat (anhydrous) soap starting with the saponification of tallow and coconut oil. An 80/20 mixture of these oils is charged to a large steel kettle, the steam turned on, caustic added and the reaction proceeds. The neat soap is then converted into liquid soap and toilet bars.

There are numerous specialized soap products which are far too small in volume to warrant attention by any but the smallest soap manufacturer. Even in this market, the products are compelled to meet severe competitive situations among the smaller firms. The products include specialty industrial soaps, mechanics' hand soap, industrial bars, etc.

Tallow has been charged in at 17¢/lb and coconut oil at 23¢. These prices are double what they were one year ago and are still rising.

In the model postulated here, glycerine has not been credited as a by-product to the soap making process since it is sent out as part of the product.

To meet the Level I guideline recommendations, the firm will be required to install surface condensers to replace the barometric legs used in refining the oil prior to saponification. This amounts to an incremental investment of $120,000. To comply with Level II requirements, an additional $30,000 for the installation of hoods, piping, etc., will be required to modify the drying operation.

For Level III technology it is assumed that a new facility would not be installed unless there were substantially more business available and imminently expected. In the kettle boil soap making process, the equipment is capable of almost indefinite use. In this study it is assumed to have a depreciable life of ten years. Because the corroded upper five feet of the tanks can be replaced and the equipment's life extended for another ten years, there is little incentive, therefore, either to replace the equipment or build new facilities.

One advantage which kettle boiling has over the continuous process is greater product flexibility in switching from one type raw material and resultant soap to another. This is lost to some degree in the continuous process.

A contractor now offers, on a turn-key basis, a fully designed 17,500,000 lb/yr plant for $890,000. This amounts to a cost of $48/1000 lbs of annual capacity in contrast to a kettle boil plant cost of approximately $100/1000 lbs of annual capacity for an equivalent volume. In addition, the continuous plant, when operating at the 4,000,000 lb/yr rate (which means operating only 80 days out of the year), shows a ten year amortized manufacturing cost of 16.2¢/lb in contrast to the kettle boil ten year amortized cost of 17.2¢/lb, the latter in full capacity operation.

It is readily apparent that if the firm can finance the initial impact of the continuous plant installation and cover its fixed costs, it is in an excellent position, from a cost standpoint, to expand the business and significantly improve the manufacturing cost and profits.

About 5,000 gallons a day of wastewater requiring treatment are generated in Levels I and II. There are "packaged" treating units which are available off the shelf that can handle this volume. They come in modular capacity units. One would choose a 10,000 gallon capacity for this installation.

The investment for such an installation as a point source discharge would amount to $80-$100,000 and require about $10,000/yr for total operating costs. Technically, this would not satisfy the need. Such packaged wastewater treating units operate almost without attention when the flow and "quality" of the influent is constant. With a widely varying industrial waste influent, it is not felt that such a plant represents a practicality.

As a result of this situation, there is no viable alternative for such a firm but to utilize a publicly owned major facility. It is the nature of a soap making facility to have an intermittent flow of the wastewater stream and a wide range in ingredient concentrations.

If the firm were located in a rural area, it might have the alternative of treatment ponds or septic tanks. Our model, which is generally representative of the location of small soap plants, is postulated as being in a large metropolitan area.

FINANCIAL ANALYSIS

This company is a small soap manufacturer considered to be a marginal company within the industry. Its annual sales are small by industry standards, $960,000. Unit sales are 4,000,000 pounds per year. This company will be analyzed from the point of view of both a lower quartile and median financial profile.

Lower Quartile Financial Data Analysis

The lower quartile data analysis is based on the use of the following key ratios to impart lower quartile industry financial characteristics to the marginal model company.

Table 17

Lower Quartile Ratio Data

Sales to net worth	2.15 X
Current debt to net worth	70.0 %
Total debt to net worth	107.8 %
Current ratio	2.19 X
Net sales to inventory	5.2 X
Average collection period	73 days
Fixed assets to net worth	46.7 %
Net profit after tax on net worth	4.88 %

Net profit after tax for this company is $21,790. The net return on net worth is 4.88 percent and the net profit margin is 2.27 percent (Tables 18, 19 and 20). In other words, the owners of this company have a return on their investment of 4.88 percent. Excluding the current money market and capital market conditions that have resulted in sharply higher and continuously rising interest rates, the return on equity for this company is considerably less than normally available from mutual savings banks and similar low risk thrift institutions. The net profit margin indicates that only 2.27 cents of every sales dollar is brought down to net profit.

These data gain more significance when compared to median data for the industry. The actual median return on net worth is 12.74 percent and the actual median net profit margin is 3.83 percent. The lower quartile company has an interest coverage of long term debt of 2.37 times, a debt/equity ratio of 107.8% and a ratio of long term debt to total capitalization of 27.4%.

Level I Technology

The application of the Level I technology mandated by July 1, 1977, involves a capital expenditure of $120,000 and an annual incremental cost including interest, depreciation, and operating costs of $54,900 for this model company. At 4,000,000 lbs/yr of product, this translates into a cost per pound of 1.37¢. The effect of incurring this cost is to increase total costs per pound of product by 5.9% and to reduce net profit from $21,790 after tax to a loss of ($22,623), which eliminates any positive return on equity. Assuming that this capital expenditure is to be financed by borrowing, debt increase by $120,000, the debt/equity ratio increases to 134.7% from 107.8%, and long term debt to total capitalization increases to 39.3% from 27.4%. Assuming a before-tax interest cost of 12%, interest coverage on long term debt declines from 2.37 times fixed charges to a negative number. It is assumed that the total amount of interest expense shown in the statement of income and expense is interest on long term debt.

Level II Technology

The application of the Level II technology mandated by the year 1983 requires a capital expenditure of $30,000 in excess of Level I above. The annual incremental costs are $8,600, which, based on 4,000,000 pounds per year of product translates into an annual incremental cost per pound of 0.215 cents. Since the Level II technology requirement is based upon the placement of both Level I and Level II equipment, the financial impact of Level II technology is considered in combination with the Level I technology discussed above. Since the incremental cost of the Level II addition is relatively small, it is likely that producers would install all of the necessary equipment to meet Levels I and II at the same time. This would probably result in some cost reduction for installation.

The combined application of Level I and Level II technologies requires a capital expenditure of $150,000 with an annual incremental cost of $63,500 in 1973 dollars. At 4,000,000 pounds of product per year, this translates into an annual incremental cost per pound of 1.59 cents. The effect of incurring this cost is to increase total cost per pound of product by an increment of 6.9 percent above the cost at time zero, and to increase the cumulative net income loss to ($31,223). There would be an increase in long term debt of $150,000. It is assumed that long term debt would increase

Table 18

SMALL MODEL SOAP PLANT - LOWER QUARTILE DATA
IMPACT ANALYSIS FOR LEVELS I, II, AND III TECHNOLOGY
COLIN A. HOUSTON & ASSOCIATES, INC. - RECOMMENDED EFFLUENT CONTROL STANDARDS

	Present Technology	Level I Technology	Level I & Level II Technology	Level III Technology	
				Batch Kettle	Continuous**
1. Annual incremental cost	-----	$54,900	$63,500	$125,000	$120,800
2. Annual incremental cost per pound of product	-----	1.37¢	1.59¢	3.14¢	3.02¢
3. Per cent change in total cost per pound of product	-----	5.9%	6.9%	13.5%	13.02%
4. Net profit margin	2.27%	-----	-----	-----	-----
5. Return on net worth	4.88%	-----	-----	-----	-----
6. Net profit before federal income tax	$32,277	($22,623)	($31,223)	($93,223)	($88,523)
7. Net profit after federal income tax (a)	$21,790	"	"	"	"
8. Interest coverage on long term debt	2.37x				
9. Increase in funded debt	-----	$120,000	$150,000*	$550,000	$840,000
10. Debt to net worth	107.8%	134.7%	141.4%	231.0%	295.9%
11. Long term debt to total capitalization	27.4%	39.3%	41.6%	61.7%	69.3%

* Cumulative, $120,000 to reach Level I and an additional $30,000 to reach Level II.

(a) After-tax profits could be reduced by tax-loss carrybacks in early years, but this represents long-term equilibrium situation.

Table 19

SMALL MODEL SOAP PLANT - LOWER QUARTILE DATA

STATEMENT OF INCOME AND EXPENSE

Net Sales	$960,000	
Less Cost of Goods Sold	724,107	
Gross Margin		$235,893
Compensation of Officers	$ 42,720	
Rent Paid on Business Property	5,952	
Repairs	5,184	
Bad Debts	1,824	
Interest Paid	13,632	
Taxes Paid	14,016	
Depreciation and Depletion	13,536	
Marketing	96,864	
Pension and Other Employee Benefits	9,888	
Total Other Expenses		$203,616
Net Profit Before Federal Income Tax		$ 32,277
Federal Income Tax		10,487
Net Profit After Tax		$ 21,790

Table 20

SMALL MODEL SOAP PLANT - LOWER QUARTILE DATA

BALANCE SHEET

ASSETS		
Current Assets		
Cash	$305,220	
Accounts Receivable	194,667	
Inventories	184,615	
Total		$684,502
Fixed Assets		208,561
Intangible and Other Assets		34,789
Total		$927,852
LIABILITIES AND CAPITAL		
Current Debt		$312,558
Long Term Debt		168,782
Net Worth		446,512
Total		$927,852

by the full $150,000, the debt/equity ratio would increase to 141.4 percent and long term debt to total capitalization increases from 27.4 percent to 41.6 percent. Interest coverage on long term debt declines from 2.36 times to near zero (0.01 times).

Level III Technology

Level III technology involves a new source of manufacture; a net addition to total plant capacity and, therefore, permits a new design for the additional production facilities. In the case of this company, Level III technology requires a capital outlay of $550,000 for a batch kettle process and $840,000 for a continuous process plant. Assuming the same 4,000,000 pound capacity production per year, this would mean an annual incremental cost over the present cost of $125,500 for the batch kettle process and $120,800 for the continuous process. Given the relative incremental costs per pound of product for the continuous process is, of course, cheaper per pound of product as well. Nevertheless, the impact of the higher total cost over the present cost structure causes a loss of ($93,223) for batch kettle and ($88,523) for the continuous process. Assuming that such an investment could be financed under these conditions, through borrowing, the debt equity ratio increases to 231% for batch kettle and 296% for the continuous process. Long term debt to total capitalization increases to 62% and 69% respectively, and the interest coverage on long term debt is negative.

Median Data Analysis

The median data analysis is based on the use of the following key ratios to impart median industry financial characteristics to this company.

Table 21

Median Ratio Data

Sales to tangible net worth	2.88 X
Current debt to net worth	35.9 %
Total debt to net worth	62.3 %
Current ratio	2.66 X
Net sales to inventories	7.6 X
Average collection period	51 days
Fixed assets to net worth	29.1 %
Net profits on net worth	12.74%

Source: Dun & Bradstreet "1971 Key Business Ratios"

Having used the small model soap plant as the marginal lower quartile company in the previous analysis, the same company will now be given the financial characteristics of the median data in order to determine whether the financial impact of effluent control is significantly dampened down by increasing the profitability of the company to conform with the median after tax return on equity for the industry. While the sales of $960,000 remain unchanged, net profit after tax rises to $42,467. The after tax return on tangible net worth is now 12.74% and the net profit margin is 4.42% (Tables 22 - 24.). In other words, the return on tangible net worth has been increased by approximately two and one-half times and the net profit margin has been increased by approximately two times. This means that this is now a relatively successful small soap manufacturer, not by any means marginal in terms of the rest of the industry, however, output has remained constant.

Level I Technology

The application of the Level I technology mandated July 1. 1977, involves a decline in net profit after tax from $42,467 to $10,604, or 75%. The net profit margin declines 3.32 percentage points from 4.42% to 1.10%, and the return on net worth declines 9.56 percentage points from 12.74% to 3.18%. Assuming that this capital expenditure is to be financed by borrowing, debt increases by $120,000, the debt equity ratio increases from 62% to 98%, and long term debt to total capitalization increases from 16 to 22%. Assuming a before-tax interest cost of 12%, interest coverage on long term debt declines from 6.02 times interest charges to 1.48 times charges.

Level II Technology

The combined application of Levels I and II technology mandated by 1983 incrementally reduces net income after tax by $38,571, or 91%. The net profit margin declines 4.01 percentage points to 0.41% (less than half a cent a dollar of sales), and the return on net worth declines 11.57 percentage points to 1.17%. Therefore, on a cumulative basis, in order to meet the 1983 standard for effluent control under the recommended guidelines and standards, the total impact will be to require a capital expenditure of $150,000 and an annual incremental cost of $63,500 in 1973 dollars. The annual incremental cost per pound of product is 1.59¢. Total cost per pound of product will increase by 7.1 percent and reduce net income to $3896, thus reducing the net profit margin to 0.41 percent and the return on net worth to 1.17 percent. Long term debt will increase by $150,000 the debt/equity ratio increases to

Table 22

SMALL MODEL SOAP PLANT - MEDIAN DATA

IMPACT ANALYSIS FOR LEVELS I, II, AND III TECHNOLOGY

COLIN A. HOUSTON & ASSOCIATES, INC. - RECOMMENDED EFFLUENT CONTROL STANDARDS

	Present Technology	Level I Technology	Level I Plus Level II Technology	Level III Technology Batch Kettle	Level III Technology Continuous**
1. Annual incremental cost	------	$54,900	$63,500	$125,500	$105,800
2. Annual incremental cost per pound of product	------	1.37¢	1.59¢	3.14¢	2.65¢
3. Per cent change in total cost per pound of product	------	6.1%	7.1%	14.1%	11.9%
4. Net profit margin	4.42%	1.10%	0.41%	-----	-----
5. Return on net worth	12.74%	3.18%	1.17%	-----	-----
6. Net profit before federal income tax	$68,495	$13,595	$4,995	($57,005)	($52,305)
7. Net profit after federal income tax	$42,467	$10,604	$3,896	($57,005)	($52,305)
8. Interest coverage on long term debt	6.02x	1.48x	1.16x	-----	-----
9. Increase in funded debt	-----	$120,000	$150,000	$550,000	$840,000
10. Debt to net worth	62%	98%	107%	227%	314%
11. Long term debt to total capitalization	16%	22%	26%	57%	67%

Cumulative - $120,000 to reach Level I and an additional $30,000 to reach Level II.

Table 23

SMALL MODEL SOAP PLANT - MEDIAN DATA

STATEMENT OF INCOME AND EXPENSE

Net Sales	$960,000	
Less Cost of Goods Sold	687,889	
Gross Margin		$272,111
Compensation of Officers	$ 42,720	
Rent Paid on Business Property	5,952	
Repairs	5,184	
Bad Debts	1,824	
Interest Paid	13,632	
Taxes Paid	14,016	
Depreciation and Depletion	13,536	
Marketing	96,864	
Pension and Other Employee Benefits	9,888	
Total Other Expenses		$203,616
Net Profit Before Federal Income Tax		$ 68,495
Federal Income Tax		26,028
Net Profit After Tax		$ 42,467

Table 24

SMALL MODEL SOAP PLANT - MEDIAN DATA

BALANCE SHEET

ASSETS

Current Assets		
Cash	$ 55,998	
Accounts Receivable	136,000	
Inventories	126,316	
Total		$318,314
Fixed Assets		97,000
Intangible and Other Assets		125,686
Total		$541,000

LIABILITIES AND CAPITAL

Current Debt	$119,667
Long Term Debt	88,000
Net Worth	333,333
Total	$541,000

107.3% from 62% and long term debt to total capitalization increases from 16% to 26.3%. Interest coverage on long term debt declines from 6.02 times to 1.16 times interest charges.

Level III Technology

Level III technology, involving a new source of manufacture requires by far the largest capital outlay, as indicated in the previous discussion of Level III requirements. The large increase in operating costs for this net addition to plant would yield a net loss of ($57,005) and ($52,305) for the batch kettle and continuous processes respectively. Assuming that such an undertaking were financed through borrowing, the debt/equity ratio increases to 227% for batch kettle and 314% for the continuous process. Long term debt to total capitalization increases to 57% and 67% respectively, and the interest coverage on long term debt is negative.

SUMMARY

This model of a marginal soap manufacturer quite clearly is very sensitive to any increase in cost that cannot be offset by an increase in price. Even small increments in net cost could cause him to close down. It is also clear that based upon this marginal performance, the company could not remain viable in the face of the costs associated with meeting the recommended effluent control guidelines and standards mandated for 1977 and 1983. The new plant appears to be out of the question under these circumstances.

By placing this company on a better financial basis using median data, the impact of the effluent control standards is reduced, but not significantly, when one considers that the viability of the firm is at stake. The impact of Levels I and II are sufficient to drive this manufacturer out of business, if all other things are held equal. Level III expansion is out of the question. A marginal company of this type is unable to raise its prices because it has only been surviving because of the price umbrella held over it by the majors.

F. MODEL OF A SMALL LIQUID DETERGENT PLANT

There are a number of small liquid detergent manufacturers who are in the private label business. A plant capable of producing about 25,000,000 pounds per year of a 50% solution of household detergent product in small packages is postulated as a model. The product is sold to local merchants where the private label material competes on the grocer's shelf with liquid detergent promoted heavily by the majors in the industry.

This relatively small operator faces the initial financial handicap of having to price his product considerably under that of the major brands, thereby reducing the margin with which he can operate. For this reason, in particular, this type of firm needs to be studied in some detail to determine if the guideline recommendations could be a threat to the continuation of his business.

For $80 - $100,000 a conveyorized automatic filling line is postulated to be installed and an additional $60-$70,000 is needed to install the required mixing vats, plumbing and cleanout units . The rest of the capital provides the lab, plant, office buildings and other attendant physical facilities required to carry out the business.

To meet the Level I guideline recommendations, this small manufacturer would have to install essentially the same type and size of equipment to minimize loss of product in cleanouts as the large manufacturer - about $50,000 in the form of tankage and additional piping.

As a point source discharger, the small liquid detergent operator could theoretically purchase a packaged wastewater treatment plant that would adequately handle his 5,000 gal/day average wastewater load.

The cost of such a unit,installed, would amount to $70,000 - $100,000 with an annual operating cost in the neighborhood of $10,000. As effective as these units are in handling specific problem loads, they would not be the acceptable solution for this sized operator. He would have two problems which the packaged unit is not prepared to cope with without a great deal of attention - that of widely varying loads over the period of a working day and concentrations of equally varying intensity. Either one of these elements would cause difficulty for a large size treating plant which is operating ordinarily at equilibrium conditions; a small unit of the size mentioned above probably 10,000 gallons capacity would be totally incapable of handling such a mixture of problems. Consequently, there is no alternative for the small liquid detergent manufacturer other than the use of a publicly owned facility, or sharing of some large private unit.

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FINANCIAL ANALYSIS

This model represents a small successful liquid detergent manufacturer. The company is analyzed with both the upper quartile and median key financial ratio previously referred to.

This model has sales of $2,950,000 with a unit output of 25,000,000 pounds. It is substantially larger than the first model with an annual output of 4,000,000 pounds and sales of $960,000 and substantially smaller than model three with an annual output of 740,000,000 pounds and sales of $214,140,000.

Upper Quartile Data Analysis

The upper quartile data analysis is based on the use of the following key ratios to impart upper quartile industry financial characteristics to the small liquid detergent plant.

Table 25

Upper Quartile Ratio Data

Sales to tangible net worth	3.87X
Current debt to net worth	24.4%
Total debt to net worth	39.4%
Current ratio	3.93%
Net sales to inventories	9.0X
Average collection period	33 days
Fixed assets to net worth	20.0%
Net profit on net worth	17.91%

Levels I and II Technology

The nature of this company's business is such that both the 1977 and 1983 standards are met simultaneously. Therefore, the only capital expenditure necessary to meet these standards is an outlay of $65,000, involving annual incremental operating costs of $18,500 for this prototype company. At 25,000,000 lbs/yr of product, this translates into a cost per pound of 0.074¢. (Tables 26, 27, and 28). The effect of incurring this cost is to increase total cost per pound of product by 0.68% and to reduce net profit after tax from $136,523 to $118,023, or 13.6%. The return on net worth declines by 2.43 percentage points and the net profit margin declines by 0.63 of 1%. Assuming that this capital expenditure is to be financed by borrowing, debt increases by $65,000, the debt/equity ratio increases by 8.5 percentage points from 39.4% to 47.9% and long term debt to total capitalization increases 6.0 percentage points from 13% to 19%. Assuming a before tax interest

Table 26

SMALL MODEL LIQUID DETERGENT PLANT - UPPER QUARTILE DATA

IMPACT ANALYSIS FOR LEVELS I, II, AND III TECHNOLOGY

COLIN A. HOUSTON & ASSOCIATES, INC. - RECOMMENDED EFFLUENT CONTROL STANDARDS

	Present Technology	Levels I and II Technology	Level III Technology
1. Annual incremental cost	-----	$18,500	$158,500
2. Annual incremental cost per pound of product	-----	0.074¢	0.634¢
3. Per cent change in total cost per pound of product	-----	0.68%	5.9%
4. Net profit margin	4.63%	4.00%	1.67%
5. Return on net worth	17.91%	15.48%	6.47%
6. Net profit before federal income tax	$248,224	$229,724	$89,724
7. Net profit after federal income tax	$136,523	$126,348	$49,348
8. Interest coverage on long term debt	16.03x	10.98x	1.96x
9. Increase in funded debt	-----	$65,000	$765,000
10. Debt to net worth	39.4%	47.9%	139.8%
11. Long term debt to total capitalization	13.0%	19.0%	53.6%

Table 27

SMALL MODEL LIQUID DETERGENT PLANT - UPPER QUARTILE DATA

STATEMENT OF INCOME AND EXPENSE

Net Sales	$2,950,000	
Less Cost of Goods Sold	2,085,226	
Gross Margin		$864,774
Compensation of Officers	$ 147,500	
Rent Paid on Business Property	18,290	
Repairs	15,930	
Bad Debts	5,605	
Interest Paid	16,520	
Taxes Paid	43,070	
Depreciation and Depletion	41,595	
Marketing	297,655	
Pension and Other Employee Benefits	30,385	
Total Other Expenses		$616,550
Net Profit Before Federal Income Tax		$248,224
Federal Income Tax		111,701
Net Profit After Tax		$136,523

Table 28

SMALL MODEL LIQUID DETERGENT PLANT - UPPER QUARTILE DATA

BALANCE SHEET

ASSETS		
Current Assets		
Cash	$132,765	
Accounts Receivable	270,417	
Inventories	327,778	
Total		$730,960
Fixed Assets		152,455
Intangible and Other Assets		179,195
Total		$1,062,610
LIABILITIES AND CAPITAL		
Current Debt		$185,995
Long Term Debt		114,341
Net Worth		762,274
Total		$1,062,610

cost of 10% (this is a lower interest rate than that charged the small soap manufacturer, because of the substantially better net profit and net worth standing of the detergent manufacturer), interest coverage on long term debt declines from 16.03 times to 10.98 times interest. (It is assumed that the interest expense shown on the income statement is interest on the long term debt portion of the total debt.)

Level III Technology

The application of Level III technology involves a new source of manufacture. It requires a capital outlay of $765,000 and an annual incremental operating cost of $158,500. With the above incremental operating costs, all other things being equal, net income after federal income tax would decline from $136,523 to $49,348 or 63.9%. The return on net worth falls to 6.47% from 17.91% and the net profit margin falls to 1.67% from 4.63%.

Assuming that such an undertaking could be financed through borrowing, the debt equity ratio increases to 139.8% from 39.4%. Long term debt to total capitalization increases from 13% to 53.6%, while interest coverage on long term debt declines from 16.03 to 1.96 times fixed charges.

Median Quartile Data

This prototype company is now viewed from the point of view of the median data profile in order to compare it to the average or midpoint performance in the industry. Net income after federal income tax is $130,497; the return on net worth is 12.74% and the net profit margin is 4.42%.

Levels I and II Technology

As has already been observed, Levels I and II are treated simultaneously. As a result of incurring the incremental annual cost of $18,500,net profit after tax declines from $130,497 to $111,997 or 14.2%. (Tables 29, 30, and 31). The return on net worth declines by 1.81 percentage points and the net profit margin declines from 4.42% to 3.80% or 0.62%. Assuming that this capital expenditure is to be financed by borrowing, debt increases by $65,000, the debt/equity ratio increases to 68.6% from 62.3% and long term debt to total capitalization increases from 20.9% to 24.7%. Assuming a before tax interest cost of 10%, interest coverage on long term debt declines from 15.36 times to 10.50 times fixed charges.

Table 29

SMALL MODEL LIQUID DETERGENT PLANT - MEDIAN DATA

IMPACT ANALYSIS FOR LEVELS I, II, AND III TECHNOLOGY

COLIN A. HOUSTON & ASSOCIATES, INC. - RECOMMENDED EFFLUENT CONTROL STANDARDS

	Present Technology	Levels I and II Technology	Level III Technology
1. Annual incremental cost	-----	$11,500	$158,500
2. Annual incremental cost per pound of product	-----	0.074¢	0.634¢
3. Per cent change in total cost per pound of product	-----	0.68%	5.8%
4. Net profit margin	4.42%	3.80%	2.67%
5. Return on net worth	12.74%	10.93%	7.69%
6. Net profit before federal income tax	$237,267	$218,767	$78,767
7. Net profit after federal income tax	$130,497	$111,997	$43,322
8. Interest coverage on long term debt	15.36x	10.50x	1.85x
9. Increase in funded debt	-----	$65,000	$765,000
10. Debt to net worth	62.3%	68.6%	136.9%
11. Long term debt to total capitalization	20.9%	24.7%	50.3%

Table 30

SMALL MODEL LIQUID DETERGENT PLANT - MEDIAN DATA

STATEMENT OF INCOME AND EXPENSE

Net Sales	$2,950,000	
Less Cost of Goods Sold	2,096,183	
Gross Margin		$853,817
Compensation of Officers	$ 147,500	
Rent Paid on Business Property	18,290	
Repairs	15,930	
Bad Debts	5,605	
Interest Paid	16,520	
Taxes Paid	43,070	
Depreciation and Depletion	41,595	
Marketing	297,655	
Pension and Other Employee Benefits	30,385	
Total Other Expenses		$616,550
Net Profit Before Federal Income Tax		$237,267
Federal Income Tax		106,770
Net Profit After Tax		$130,497

Table 31

SMALL MODEL LIQUID DETERGENT PLANT - MEDIAN DATA

BALANCE SHEET

ASSETS

Current Assets		
Cash	$ 172,076	
Accounts Receivable	417,917	
Inventories	388,158	
Total		$ 978.151
Fixed Assets		298,073
Intangible and Other Assets		386,225
Total		$1,662,449

LIABILITIES AND CAPITAL

Current Debt	$ 367,726
Long Term Debt	270,417
Net Worth	1,024,306
Total	$1,662,449

Level III Technology

The application of Level III technology is for a new source manufacture. It requires a capital outlay of $765,000 and an annual incremental cost including interest, depreciation, and operating costs of $158,500. With the above incremental operating costs, all other things being equal, net income after federal income tax declines from $130,497 to $43,322 or 66.8%. The return on net worth declines to 7.69% from 12.74% and the net profit margin declines to 2.67% from 4.42%.

Assuming that such an undertaking were financed through borrowing, the debt/equity ratio increases to 136.9% from 62.0%. Long term debt to total capitalization increases from 20.9% to 50.3%, while interest coverage on long term debt declines from 15.36 times to 1.85 times interest charges.

Summary

This liquid detergent manufacturer is substantially affected by the effluent control costs in terms of significantly reduced profitability. By meeting the 1983 standard, the upper quartile data return on tangible net worth will decline by 2.43 percentage points, and the net profit margin will decline by 0.63 of one percent. There is also a rapid rise in debt relative to the equity base with a decline in the ability to service that debt. Of course the supposition that the control equipment is financed by debt is only one possibility in this case, but a reasonable one. The Level III new plant technology would seem to be a burdensome undertaking under the constraints of this analysis where all other things are held constant.

G. MODEL OF A LARGE INTEGRATED PLANT

An integrated manufacturing facility, such as the theoretical one described below, is representative of a plant that would be operated by one of the four largest companies in the soap and detergent industry.

Table 32

Model of a Large Soap and Detergent Plant

Process	Annual Production
Kettle Boil Soap Manufacture	30,000,000 lbs/yr
Fatty Acids From Fat Splitting	50,000,000 lbs/yr
Glycerine Recovery/Distillation	10,000,000 lbs/yr
Bar Soap Manufacture	30,000,000 lbs/yr
Oleum Sulfonation *	120,000,000 lbs/yr
Air/SO_3 Sulfonation *	25,000,000 lbs/yr
Spray Dried Detergent Manufacture	600,000,000 lbs/yr
Liquid Detergent Manufacture	50,000,000 lbs/yr

* These processes will not, in themselves, be impacted to any significant degree by the guideline recommendations. However, to provide the basic raw materials for other processes, they would be found as part of such a plant.

Kettle Boil Soap Manufacture

Neat soap (70% soap solution in water) is prepared from a mixture of 80/20 tallow/coconut oil. The neat soap is composed of the sodium salts of the fatty acids and is made by reacting them with caustic soda. The fats are costed into the process at 17¢/lb for tallow and 23¢/lb for the coconut oil. These prices will not represent true costs in the near future because of a rapidly escalating fats and oils market. They were but one half the values shown only one year ago. Glycerine in a concentration of 8 - 10% is produced as a by-product in the manufacture of soap. The weak glycerine is customarily concentrated to 80% by the soap manufacturer but may be sold to an outside glycerine producer for 13½¢/lb (on an 80% basis). In any event, a credit is made to the soap process. For this economic model, an arbitrary value of 10¢/lb has been assigned on the basis of 100% glycerine. This product will be charged into the glycerine recovery unit at this same price.

In Level I technology, the barometric condenser used in the vacuum bleaching of the oils is considered to have been replaced by a surface condenser, thereby cutting down significantly on the BOD_5. All of the neat soap is presumed to be consumed in the production of toilet bars.

In Level II technology, there is a requirement that the BOD_5 readings must be below those of Level I. To achieve this, new capital will be required for the purchase and installation of equipment to modify present drying processes and thus minimize wastewater loadings.

Level III is assumed to have incorporated all of the improvements which were required in Levels I and II without a basic alteration of the bar making process.

Fatty Acid Manufacture by Fat Splitting

Tallow, at a price of 17¢/lb, is the fat presumed for this operation. In actual operation a fat splitter is not restricted to one raw material. By-product glycerine is combined with that obtained from the soap making step and run into an independent glycerine recovery and distillation unit. On the same basis as in soap manufacture, a credit of 10¢/lb for glycerine is credited to the fat splitting operation. Present industry practice utilizes from 50 to 9300 gallons of water/1000 lbs of fatty acid produced. It is assumed that by the replacement of presently used barometric condensers with surface condensers, significant reduction in the wastewater generated and the BOD_5 can be effected. A flow of 100 gallons of wastewater/1000 lbs of acid produced is assumed to be attainable and the capital to attain this performance, invested.

Glycerine - Concentration and Distillation

Dilute glycerine streams from the manufacture of neat soap and from the splitting of fats are combined and run through triple effect evaporators which concentrate the glycerine from 8 - 15% to 80%. The 80% glycerine is then run to a glycerine still where the material is taken overhead as 99+% product. To meet the Level I guidelines, the barometric condenser has to be replaced by a surface condenser. This requires the investment of $210,000 of new capital.

With a surface condenser, the amount of glycerine carryover into the condensate water would be less. This in turn would reduce the present heavy BOD_5 loadings. In addition, it would also lower the volume of water used from the industry range of 120 gallons to 185,000 gallons/1000 lbs of glycerine produced. The same equipment is expected to be employed to meet Levels II and III. In the distillation step, the capital requirement for the surface condenser is approximately $70,000 at the 10 million lb/year level.

Oleum Sulfonation

For the most part, this process causes very little contribution to the waste loadings. No added capital is expected to be required for most plants to meet the guidelines. This is true for all three technology levels. In the model in Level III, the expectancy is that the Chemithon continuous process or its equivalent would be the process of choice because of its low capital requirements and very low operating costs. Its effluent generation is also minimal. By no means is this regarded as a requirement - just a very high probability that either it or its equivalent would be chosen in a new installation.

Air/SO_3 Sulfonation

This operation is expected to furnish the appropriate sulfonated products to the liquid detergent function. In most instances, the process produces minimum effluent. In Level III technology, the capital is indicated to be lower than the average for now-in-place equipment. The expectancy that a new, more efficient installation would employ the equivalent of a new Chemithon unit or equivalent for which a firm estimate of capital and operating costs was received.

Spray Dried Detergents

Active ingredient made in the oleum sulfonation unit is blended with the required soil dispersants, perfumes, brighteners, etc., in the crutcher, dissolved in water to about a 70% slurry concentration and then pumped to the top of the spray drying tower. There the slurry is sprayed into a stream of very hot air where the appropriate sized particles are formed.

In Level II technology, the multiple guidelines are reduced to one. Some revamping of the exit hot air scrubbing system is expected to be required to meet Level III. The equipment train is a set of "vortex" dust collectors followed by two tandem water scrubbers. The first scrubber would be operated near the 70% slurry concentration and serve to knock out the largest portion of particulate matter and chill the air stream (this particular scrubber flow would be refrigerated to maintain its chilling capacity). Periodically it would be bled off into the crutcher for recycle of the solids. Make-up and dilution water would be obtained from a bleed off of the second stream. It would be operated at considerably lower concentration levels than the first scrubber system. It would pick up the residual, chilled particulate matter to make a system of approximately 99.9% effectiveness of particulate removal of particle sizes of one micron or larger.

In the prototype plant having two-300 million pounds per year spray drying towers the additional capital for these installations is estimated to be about $500,000. This same installation would be expected to meet Level III.

Liquid Detergents

Active ingredients will mainly come from the Air/SO_3 sulfonation unit.They will be blended with appropriate hydrotropes, perfumes, etc., and run to a filling conveyor system where they will be poured into various size bottles. In this operation either pressure or vacuum filling equipment will be used, with heavy emphasis expected upon the pressure equipment due to the preponderance of plastic bottle employed. They would partially collapse under the vacuum system and inhibit appropriate level control in the filling.

There is indeed some loss of product due to the operation of the conveyor filling line, but ordinarily the largest loss (and highest BOD_5 loadings)occur when the equipment is cleaned out between runs, particularly of different products. This cleanout is deemed necessary so that there will be no cross contamination of products having different colors, perfumes, incompatible ingredients (which could cause clouding of solutions, etc.)

For Level I technology, there will probably be a requirement on the part of several firms to install additional holding tanks to allow greater amounts of recycle of the washout materials. In addition, for Level II technology there will probably be a need to modify the piping systems to allow air or steam to be used for the cleanout of transfer lines.

Additional capital requirement to meet Level I technology is estimated to be $100,000 for a 50 million pound per year plant - and an equivalent amount is needed to meet Level II technology.

WASTEWATER VOLUME GENERATION

Use of the above changes should substantially reduce the wastewater generated in the processes. To get some idea of the magnitude of the possible reduction, noted below is the anticipated new wastewater volumes versus the present industry use range.

Table 33
Wastewater Generation - Present vs Expected

Process	Current Range* gal/1000 lbs Anhydrous Product	Model Use* gal/1000 lbs Anhydrous Product
Soap Manufacture (neat)	25 - 2345	150
Bar Soap Manufacture	8 - 750	300
Fat Splitting	50 - 9300	100
Glycerine Recovery	120 - 185,000	50
Oleum Sulfonation	12 - 300	15
Air/SO_3 Sulfonation	.3 - 240	15
Spray Drying	14 - 228	30
Liquid Detergent	70 - 750	80

*The designation of gal/1000 lbs relates the water usage per 1000 lbs of anhydrous product produced in the unit described.

POLLUTANT CONCENTRATION

Further comment needs to be made on this subject to lend a degree of cogency to the arguments offered above in the model description for the improvements recommended in the capital equipment. While reviewing the industry data, the wide variation in water used per unit of product produced became glaringly apparent. Of equal interest was the fact that two plants having very widely divergent amounts of water used to manufacture a unit of product, also had raw waste loadings almost identical per unit of product coming out of the end of the pipe. This means that the concomitant production of the particular contaminants are fixed. The manufacturer having the more dilute stream appears to be the "better citizen" when, in fact, it is not true. The changes incorporated in the prototype are expected to reduce both the hydraulic loadings and the contaminant concentrations.

TREATMENT PLANT

The hydraulic loading on the treatment plant is expected to be considerably reduced over current industry practice due to the installation of the surface condensers. A flow of about 160,000 gallons/day is anticipated with a BOD_5 of the range of 1,000 - 1,500 mg/liter. With this flow and loading the capital cost is estimated to be of the order of $600,000 having an operating cost of approximately $90,000. If the concentration is closer to the 2,000 - 3,000 mg/l range, then the capital indeed might double. The treatment is expected to yield an effluent with a BOD_5 of less than 50 mg/liter.

FINANCIAL ANALYSIS

This company is a large integrated company producing several different products within the soap and detergent industry. Such an establishment would conform to the plants of the so-called "big three" companies in the industry. This company, like the other two prototypes, is analyzed from the point of view of two different financial profiles. In this case, the two profiles will be constructed from the upper quartile and median data.

Upper Quartile Data Analysis

The upper quartile data analysis is based on the use of the key ratios to impart upper quartile industry financial characteristics to the large integrated plant.

This company has sales of $214,140,000 with a unit output of 740,000,000 lbs/yr of product. Net profit after tax is $9,910,200. The net return on net worth is 17.91% and the net profit margin is 4.63%. (The net profit margin is understated here because it is a derived figure. The Dun & Bradstreet survey figure is 7.10%.)

Level I Technology

The application of Level I technology mandated by July 1, 1977, involves a capital expenditure of $570,000 for in-plant control plus $600,000 for end-of-pipe treatment, or a total of $1,170,000, and an annual incremental cost of $402,600 for this model. At $740,000,000 lbs/yr of product, this translates into a cost per pound of 0.0544¢. (Tables 34,35 and 36). The affect of incurring this cost is to increase total cost per pound of product by 0.21% and to reduce net profit from $9,910,200 to $9,700,848 after taxes or 2.1%. The return on net worth falls by 0.38 percentage points, and the net profit margin falls by 0.10 percentage points. Assuming that this capital expenditure is to be financed by borrowing, debt increases by $570,000, the debt/equity ratio increases one percentage point to 40.4% and long term debt to total capitalization increases 0.8 of a percentage point to 13.8%. Assuming a before tax interest cost of 8%, interest coverage on long term debt declines to 27.9 times from 32.8 times. It is assumed that one-half of the interest expense shown in the income statement is interest on long term debt.

Level II Technology

The application of Level II technology mandated for 1983 requires an incremental capital investment of $600,000 and annual incremental costs of $212,000. Combining the financial impact of Levels I and II technology, there is a combined capital expenditure of $1,770,000 and an additional annual incremental cost of $614,600. At 740,000,000 pounds of product per year this translates into an annual incremental cost per pound of 0.0831 cents. The affect of incurring this cost is to increase total cost per pound of product by an increment of 0.31 percent above the cost at time zero and to reduce net income by 3.2 percent below the net income at time zero. There will be an increase in long term debt of $1,770,000, assuming that the equipment is financed through the use of debt.

Return on net worth falls 0.58 of one percent to 17.33 percent and the net profit margin declines to 4.48 percent from 4.63 percent. Long term debt increases by $1,770,000 the debt/equity ratio increases to 42.6 percent from 39.4 percent and long term debt to total capitalization increases from 13 percent to 15.4 percent. Interest coverage on long term debt declines from 32.8 times to 25.9 times interest.

Table 34

LARGE MODEL INTEGRATED PLANT - UPPER QUARTILE DATA

IMPACT ANALYSIS FOR LEVELS I, II, AND III TECHNOLOGY

COLIN A. HOUSTON & ASSOCIATES, INC. - RECOMMENDED EFFLUENT CONTROL STANDARDS

	Present Technology	Level I Technology	Level I & Level II Technology	Level III Technology Continuous
1. Annual incremental cost	-----	$402,600	$614,600	$3,107,000
2. Annual incremental cost per pound of product	-----	0.0544¢	0.0835¢	0.4199¢
3. Per cent change in total cost per pound of product	-----	0.21%	0.31%	1.41%
4. Net profit margin	4.63%	4.53%	4.48%	3.87%
5. Return on net worth	17.91%	17.53%	17.33%	14.99%
6. Net profit before federal income tax	$19,058,076	$18,655,476	$18,443,476	$15,951,076
7. Net profit after federal income tax	$9,910,200	$9,700,848	$9,590,608	$8,294,560
8. Interest coverage on long term debt	32.8x	27.9x	25.9x	8.4x
9. Increase in funded debt	-----	$1,770,000	$1,770,000	$19,000,000
10. Debt to net worth	39.4%	41.5%	42.6%	73.7%
11. Long term debt to total capitalization	13.0%	14.6%	15.4%	33.0%

Level III Technology

Level III technology involves a new source of manufacture. It requires a capital outlay of $19,000,000 for a continuous process plant and annual incremental operating costs of $3,107,000.

With the above incremental operating costs, all other things being equal, net income would decline from the time zero model of $9,910,200 to $8,294,560, or 16.3%. The return on net worth declines from 17.91% to 14.99% or 2.92 percentage points. The net profit margin declines 0.76 percentage points from 4.63 to 3.87%.

Assuming that such an undertaking were financed through borrowing, the debt equity ratio increases to 73.7% from 39.4%. Long term debt to total capitalization increases to 33% from 13%. Interest coverage declines from 32.8 times interest to 8.4 times.

Median Data Analysis

The median data analysis is based on the same key ratios used in the median data analysis of the small model soap plant. The purpose of giving this integrated company a median financial profile is to determine the impact of the effluent control standards on a somewhat less successful large integrated company, thus obtaining a more rigorous test of the impact of the costs of effluent control.

The company's sales remain at $214,140,000. Net profit after tax is now $9,472,720, return on net worth is 12.74%, and the net profit margin is 4.42% (Tables 35, 36 and 37).

Level I Technology

The application of Level I technology mandated by July 1, 1977, involves the same capital expenditure and annual incremental cost required in the upper quartile data. In this instance, however, net profit after federal income tax declines by 2.2% and the return on net worth declines by 0.28 percentage points from 12.74% to 12.46%. The net profit margin declines by 0.09 percentage points, from 4.42% to 4.33%. Assuming that this capital expenditure is to be financed by borrowing, debt increases by $570,000 for in-plant control plus $600,000 for end-of-pipe treatment, for a total of $1,170,000. The debt/equity ratio increases .08 percentage points to 63.1% and long term debt to total capitalization increases 0.5% to 63.1%. Assuming a before tax interest cost of 8%, interest coverage on long term debt declines from 31.8 times to 27.70 times interest. (It is assumed that one-half of the interest expense shown in the income statement is interest on long term debt.)

Level II Technology

The application of Level II technology mandated for 1983 requires an incremental capital investment of $600,000 and an additional annual incremental cost equal to $212,000.

Combining the effects of Levels I and II, the attainment of the 1983 recommended standards requires a total capital expenditure of $1,770,000 and an annual incremental cost of $614,600 in 1973 dollars. The incremental cost per pound of product is 0.0831 cents. This will increase total cost per pound of product by 0.31% and reduce net income by 3.4%. The return on net worth falls to 12.31%, a decline of 0.43%. The net profit margin declines by 0.15% to 4.27%. Long term debt increases by $1,770,000, the debt/equity ratio increases to 64.7% and long term debt to total capitalization increases from 20.9% to 22.3%. Interest coverage on long term debt declines from 31.38 times interest to 24.75.

Level III Technology

Level III technology involves a new source of manufacture. It requires a capital outlay of $19,000,000 for a continuous process plant and annual incremental operating costs of $3,107,000. With these operating costs, all other things being equal, net income would decline from the time zero model of $9,472,720 to $7,857,080 or 17.1%. The return on net worth declines from 12.74% to 10.57% or 2.17 percentage points; the net profit margin declines 0.75 of a percentage point from 4.42% to 3.67%.

Assuming that such an undertaking were financed through borrowing, the debt/equity ratio increases to 87.9% from 62.3%. Long term debt to total capitalization increases to 34.2% from 20.9%. Interest coverage declines from 31.38 times interest to 7.97 times.

Summary

This static analysis of the large integrated plant indicates that meeting the 1983 standards will entail an appreciable cost regardless of the financial profile used. In the case of the upper quartile data, the return on net worth will decline by 0.58%, from 17.91% to 17.33%. This reflects the annual incremental cost of $614,600. Using the median data there is 0.43% decline in the return on a larger net worth. Put another way, each percentage point decline in the return on net worth represents a cost of $10,000 per million dollars of net worth.

This represents a substantial potential cost in meeting the 1983 standards. The cost, however, only becomes burdensome if the company cannot increase its prices by an amount sufficient to offset the cost increase.

Table 35

LARGE MODEL INTEGRATED PLANT - UPPER QUARTILE DATA

STATEMENT OF INCOME AND EXPENSE

Net Sales	$214,140,000	
Less Cost of Goods Sold	116,171,334	
Gross Margin		$97,968,666
Compensation of Officers	$ 2,227,056	
Rent Paid on Business Property	1,327,668	
Repairs	1,156,356	
Bad Debts	406,866	
Interest Paid	1,199,184	
Taxes Paid	3,126,444	
Depreciation and Depletion	3,019,374	
Marketing	64,242,000	
Pension and Other Employee Benefits	2,205,642	
Total Other Expenses		$78,910,590
Net Profit Before Federal Income Tax		$19,058,076
Federal Income Tax		9,147,876
Net Profit After Tax		$ 9,910,200

Table 36

LARGE MODEL INTEGRATED PLANT - UPPER QUARTILE DATA

BALANCE SHEET

ASSETS		
Current Assets		
Cash	$ 9,637,406	
Accounts Receivable	19,629,499	
Inventories	23,793,333	
Total		$53,060,238
Fixed Assets		11,066,666
Intangible and Other Assets		13,007,762
Total		$77,134,666
LIABILITIES AND CAPITAL		
Current Debt		$13,501,333
Long Term Debt		8,300,000
Net Worth		55,333,333
Total		$77,134,666

Table 37

LARGE MODEL INTEGRATED PLANT - MEDIAN DATA

IMPACT ANALYSIS FOR LEVELS I, II, AND III TECHNOLOGY

COLIN A. HOUSTON & ASSOCIATES, INC. - RECOMMENDED EFFLUENT CONTROL STANDARDS

	Present Technology	Level I Technology	Level I + Level II Technology	Level III Technology Continuous
1. Annual incremental cost	-----	$402,600	$614,600	$3,107,000
2. Annual incremental cost per pound of product	-----	0.0544¢	0.08035	0.4199¢
3. Per cent change in total cost per pound of product	-----	0.21%	0.31%	1.59%
4. Net profit margin	4.42%	4.33%	4.27%	3.67%
5. Return on net worth	12.74%	12.46%	12.31%	10.57%
6. Net profit before federal income tax	$18,216,770	$17,814,170	$17,602,170	$15,109,770
7. Net profit after federal income tax	$9,472,720	$9,263,368	$9,153,128	$7,857,080
8. Interest coverage on long term debt	31.38x	26.70x	24.75x	7.97x
9. Increase in funded debt	-----	$1,170,000	$1,770,000	$19,000,000
10. Debt to net worth	62.3%	63.9%	64.7%	87.9%
11. Long term debt to total capitalization	20.9%	21.9%	22.3%	34.2%

Table 38

LARGE MODEL INTEGRATED PLANT - MEDIAN DATA

STATEMENT OF INCOME AND EXPENSE

Net Sales	$214,140,000	
Less Cost of Goods Sold	117,012,640	
Gross Margin		$97,127,360
Compensation of Officers	$ 2,227,056	
Rent Paid on Business Property	1,327,668	
Repairs	1,156,356	
Bad Debts	406,866	
Interest Paid	1,199,184	
Taxes Paid	3,126,444	
Depreciation and Depletion	3,019,374	
Marketing	64,242,000	
Pension and Other Employee Benefits	2,205,642	
Total Other Expenses		$78,910,590
Net Profit Before Federal Income Tax		$18,216,770
Federal Income Tax		8,744,050
Net Profit After Tax		$ 9,472,721

Table 39

LARGE MODEL INTEGRATED PLANT - MEDIAN DATA

BALANCE SHEET

ASSETS

Current Assets		
Cash	$12,490.967	
Accounts Receivable	30,336,483	
Inventories	28,176,315	
Total		$71,003,765
Fixed Assets		21,637,062
Intangible and Other Assets		28,035,984
Total		$120,676,811

LIABILITIES AND CAPITAL

Current Debt	$26,693,145
Long Term Debt	19,629,500
Net Worth	74,354,166
Total	$120,676,811

III. SUMMARY OF ECONOMIC ANALYSIS

The above analysis was made under fairly rigid constraints in order to determine the impact of the cost of effluent control under the recommended standards. Because of these constraints, and the use of a static analysis, factors that would tend to lessen the financial impact of control were not considered.

The assumption of a constant annual output permits no offset to the control costs from increased sales. Of course sales can also decrease, but the expectation is that future industry growth will continue through the decade at approximately three percent per year.

The lack of any provision for debt retirement of existing debt over time magnifies the debt/equity ratio and also tends to magnify the burden of the debt. In the same vein, the lack of any provision for the build-up of net worth over time from retained earnings also tends to magnify the burden of the debt financing. It is cheaper to carry this debt than to retire it. It is also cheaper to use debt funds than equity funds.

The assumption that the equipment necessary to meet the effluent control requirements will be financed totally through debt, while not unrealistic, is somewhat overstated in some cases since these facilities can also be financed through equity funds as well. If financed with equity funds, there would be no increase in the debt equity ratio or in fixed charges. Another alternative would be to finance the control equipment in part with the debt fund and in part with equity funds.

If at the time capital costs are incurred for control purposes, there exists an investment tax credit. this would further reduce total control costs. By far the most important constraint, however, is the assumption of a constant price. In an industry characterized very largely by price inelasticity of demand, one must expect that the increased cost of effluent control will ultimately be born by the consumers of the industry's products. This is as it should be since effluent control is properly a cost incurred in the manufacture of the product and should be embodied in the price of that product. Therefore, the costs discussed above will no doubt be covered by price increases of equal magnitude.

The company models conform to descriptions of industry Segments I and III as defined earlier in this report. The large integrated plant is a Segment I company, while the small soap manufacturer and the small liquid detergent manufacturer are Segment III companies. For reasons discussed under methodology, there are no Segment II models.

It should be noted, with reference to the use of upper quartile, median and lower quartile data, that the upper quartile key ratios represent data for a point midway between the median and the top of the series. Therefore, of the companies above the median, there are an equal number above and below the upper quartile ratios. By the same token, by definition, the median is used as the half-way point of the data and, therefore, the three model companies given the median financial characteristics of the industry provide a good indication of the impact of the proposed effluent control guidelines and standards. Since there are an equal number of companies above and below the median, one cannot conclude that the impact observed here is the expected impact for every company. Rather, one can observe that half of the establishments in the industry will do better than the median results while half will do less well. It may further be observed that of the establishments below the median, half will do better than the lower quartile performance, while half will do less well.

A. PRICE EFFECTS

Based on the foregoing financial impact analysis, it is clear that (1) there is an incremental cost associated with point source members of the soap and detergent industry meeting the recommended effluent control standards and guidelines and (2) that this cost is substantial. In addition, it is noted that point source treatment is one of two alternatives often open to a large member of the industry in meeting the control standard within the framework of an ongoing business; the other alternative is interconnection with a public waste treatment facility. In either case, there is either an actual or potential incremental cost.

In a market characterized by vigorous price competition, limited market power among the participants, and a relatively homogeneous product, the expectation would be that the incremental cost of control would induce prices of product to rise to cover the above cost increments, or alternatively, for the producers of product to increase productivity in order to offset the effect of the additional cost on profit margins.

This market has previously been characterized as oligopolistic in recognition of the high degree of concentration of production facilities and sales among few producers. It was indicated that the market is further characterized by a high degree of product differentiation and considerable market power among the "big three". Since this is an oligopolistic market, one cannot specify with certainty the price effects of meeting the proposed effluent control standards because they are to a great extent, discretionary.

THE "BIG THREE"

The big three producers, Procter & Gamble, Lever Brothers, and Colgate-Palmolive may either (1) absorb the incremental cost, (2) increase their price by an amount equal to the incremental cost, or (3) increase their price by an amount greater than the incremental cost of effluent control.

Since the price making process of necessity involves time lags; for example, between rising costs and an upward price adjustment, the oligopolist can build into any particular price increase, an increment for future expected near-term cost increases. This would permit the absorbing of some cost increases without adversely affecting the target profit margin or rate of return. If this is the case with the "big three" at this point in time, they might well absorb the incremental cost associated with effluent control, but it is not a likely alternative if such a course of action would squeeze the profit margin of competitors since further gains in market share by the big three, at the expense of other competitors, might invite a governmental antitrust action.

If the effluent control cost were to cut into the target profit margin or rate of return significantly, a price increase equal to the incremental cost would be expected. If this incremental cost increase coincides with other cost increases, there could be a price increase greater than the incremental cost of effluent control.

PRIVATE BRAND HOUSEHOLD SOAP AND DETERGENT

The private brand producers of soaps and detergents must be cognizant of the price differential between the private brands and the nationally advertised brands. Therefore, their ability to institute price increases are, to a great extent, a function of the price differential between private brands and nationally advertised brands, and therefore, a function of the price of the nationally advertised brands. Substantial shrinkage of the differential would cause a loss of market share from the private brands to the nationally advertised brands. Bearing in mind these considerations, there results a price leadership situation, so common a characteristic of the oligopolistic market. The price leadership is exerted by a member of the "big three", possibly Procter & Gamble; the other two of the largest three producers would follow, in line with the previously outlined characteristics of mutual interdependence in the oligopolistic market. The private brand makers would also follow suit. The private brand makers may be able to fully offset or partially offset increased costs, depending on the magnitude of the price increase of the price leader and the resulting net effect on the price differential between national and private brands.

INDUSTRIAL AND INSTITUTIONAL CLEANERS

These producers of specialty products will be able to increase price depending on how successful they have been in differentiating their product. Generally, specialty products, by definition, are highly differentiated, and therefore prices can be increased with relative ease. This product line is characterized by a few relatively large producers; e.g., the Chemed Division of W. R. Grace & Co., and Economics Laboratory and a large number of small companies. Since product differentiation is rarely if ever complete, some cross elasticity of demand; i.e., substitutability, must exist.

GLYCERINE PRODUCERS

The natural glycerine supply is a by-product of soap manufacture and/or fat splitting. Natural glycerine, therefore, is marketed on a continuous basis regardless of immediate market conditions. The price determined in the market for natural glycerine determines the price for synthetic glycerine. Since the recommended effluent control standards will increase the cost of recovering natural glycerine, there may follow a price increase to cover that incremental cost increase. As the "big three" are the dominant natural glycerine producers, any price increase would probably originate with them and filter down through the industry.

SUMMARY

Taking into consideration the structure of the industry, the inelastic situation with respect to price elasticity of demand and the ever-present threat of governmental action in the face of further concentration within the soap and detergent industry at the expense of the smaller producers, it is reasonable to expect that the cost of meeting the recommended standards and guidelines for effluent control will result in a price increase of a magnitude equal to the cost increment.

The discussion of price, production, employment, community, industry growth, and balance of trade effects cannot be considered on a model by model basis. The basic parameters are those of the major producers, insofar as they are limited in their price movements by the actions of these major producers. The plant models are not nearly as important as the overall industry economics in determining price, production, and balance of trade effects.

B. PRODUCTION EFFECTS

The recommended guidelines will affect production in many ways. The most important are discussed below.

Equipment Installation

The capital equipment which may be required for in-process modification to meet guideline recommendations will interrupt the normal processing activities. Not every plant within a particularly impacted category will be affected since many are already at the equivalent of the Level I or Level II guideline recommendations.

Replacement of barometric condensers by surface condensers is by far the most controversial issue within the industry. There is relatively little disagreement over the utility and operability of such equipment in glycerine recovery and distillation. This is not the case regarding its use in soap drying and fatty acid distillation.

Several of the manufacturers have advised the guidelines contractor that the employment of the surface condenser in soap drying would lead to rapid fouling of the condenser surface, thereby requiring frequent shutdowns to clean out the condensers. The process change may require piloting before scale-up and installation. Once this controversy is resolved affirmatively there is no work stoppage foreseen.

The fatty acid producers are also challenging the surface condenser replacement for barometrics. They claim the low melting point of some of the acids would offer a fouling problem similar to that of the soap drying process. There are several approaches which could accomplish the same water and effluent reductions as surface condensers such as extraction of light ends from the vapor effluent from the still or the recycle of barometric condenser cooling water through a biological cooling tower. Nothing in the guideline recommendations mandated the incorporation of particular hardware.

In terms of installation interference, an expected several days' interruption can be expected to make the plumbing tie-ins of the installed units. As much as two weeks shutdown is an outside limit.

Similarly, the installation of the suggested water scrubbers would require several days' down time of the spray towers in order for the plumbing tie-ins to be made. Here again, the knowledge of similar types of equipment used elsewhere in the chemical industry as a very common practice lessens the threat of unanticipated difficult installation practices.

In the case of the liquid detergent plants making the appropriate changes to minimize their loss of product due to cleanouts, most of this equipment could be installed without interrupting the general performance of the filling lines. There would come a time when the plant would have to shut down for the necessary piping tie-ins which would amount to a few days at most. There would be no yield losses, production losses, or other noticeable change in operation after the changes are made.

Operation Costs

There will be an increase in the cost of operation caused by the installation of these new units of process equipment. There will also be an attendant recovery of product or byproduct which will provide a payout (payback) - even though of long duration in some cases.

Production Curtailment

Whatever interference there is with the manufacturing process, it will only be temporary during installation and startup.

Plant Closings

No plant closings are foreseen due to equipment incompatability or difficulty of installation. This is above the consideration of economics. From a strictly engineering vantage point, there is no reason to predict any insuperable problem.

Industry Growth

Growth will be unimpeded at the expected annual rate of 5% (in pounds). Whatever increase in operation costs that would be incurred can be expected to be passed on to the consumer.

The soap business is expected to just keep pace with population growth. In the event a new plant is built from "grassroots", there is strong probability a new soap manufacturing unit would utilize the continuous saponification unit rather than the older batch kettle equipment. The new continuous unit offers lower unit costs but does not offer the flexibility of product type enjoyed by the older plant.

C. EMPLOYMENT AND COMMUNITY EFFECTS

The employment effects of the recommended standards and guidelines for effluent control will be slight if there are any effects at all. Since it is the expectation that price increases will offset the cost of effluent control, there is little reason to expect production curtailment to be a resultant effect of the institution of the recommended standards. In addition, given the nature of the industry with respect to its size distribution there is little expectation of an unfavorable employment effect since the large plants are owned by those industry members that can best cope with a rising cost situation.

The geographical distribution of the industry also minimizes the possibility of unfavorable employment and community effects. It is not likely that a soap detergent plant will be the economic mainstay of a community. These plants are generally located in well populated, highly industrialized areas.

It is, therefore, concluded that the employment and community effects of the recommended effluent control standards and guidelines will be neutral.

balance of payments effect initially. (The secondary balance of payments effects are dependent upon many other variables relating to the policy of this potential foreign competitor with respect to reinvesting in the United States as opposed to repatriating earnings to the foreign competitor's country of origin. Fourth, it is noted that the major industrial nations, apart from the United States, are experiencing significant inflation, further reducing any potential advantage that might develop from the costs associated with the recommended effluent control standards. Fifth, and last, foreign industrial nations are recognizing and have already recognized and reacted to, the threats to the environment represented by water pollution. Many countries have already enacted control requirements.

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D. INDUSTRY GROWTH AND BALANCE OF PAYMENTS EFFECTS

Demand Characteristics

The growth of the industry is primarily dependent upon the key demand variables which are demographic in nature. Since the product is highly differentiated with no close substitutes, and since it is relatively income inelastic as well as price inelastic, the added cost associated with the recommended control standards should be neutral in effect with respect to growth.

Supply Characteristics

There is no doubt that the cost of doing business will rise as a result of the control standards and guidelines. However, as has already been pointed out, these operating costs will be offset by price increases. There will be no raising of the barriers to entry into the industry since there will be no increase in capital requirements in an overwhelming majority of cases. Although the cost estimating process employed in this study utilized point source estimates with incremental additions to real capital, it is the industry practice to hook up to public water treatment facilities in all but a very few cases. Therefore, no incremental capital costs are involved in all but a very few cases.

Another supply side phenomenon that must be considered is the possibility that demand will be partially satisfied from abroad due to the cost increases associated with effluent control. This would lead to a negative effect with respect to the growth of the domestic soap and detergent industry. Such an eventuality is unlikely under present circumstances, for a variety of reasons. First, any exporter of product to this country must contend with a 5% *ad valorem* import tax as well as high freight rates. Second, given the nature of the industry, in order to gain a market share any potential foreign competitor would have to almost certainly take on the "big three" either with respect to direct price competition or in terms of out advertising them - a formidable task. Third, devaluation of the dollar with respect to other hard currency exchange tends to place potential foreign producers in an unfavorable relative price position vis-a-vis the dollar. Any potential foreign competitor would be more likely to build a plant in the United States. This would yield a favorable employment and community effect and have a favorable

IV. LIMITS OF THE ANALYSIS

The limitations of this analysis have been stated in the body of the text both in the statements of methodology and in the analysis itself. Perhaps the single greatest limitation has been the limitation created by the availability of data on a plant and company basis. However, these limitations are always present in a study such as this and it requires the analyst to find proxies that are reasonable approximations of the desired data -- this we have done.

The second major limitation has been the impossibility of directly measuring future public sewer treatment costs and their impact on effluent control. Here again, however, we feel that we have established a reasonable alternative route in arriving at the economic impact of the guidelines and standards.

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